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(71)Applicant : CCS INC
(72)Inventor : MASUMURA SHIGEKI
YONEDA KENJI
SUGITA TAKASHI

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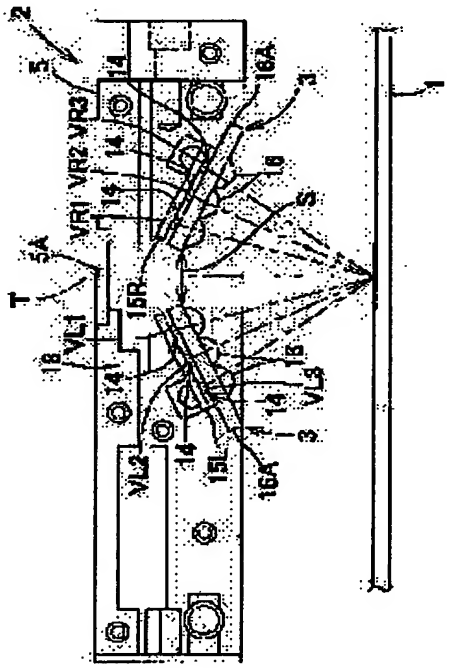
(54) LIGHTING SYSTEM FOR INSPECTION

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a lighting system for surface inspection capable of uniformly lighting every part without generating a dark part.
SOLUTION: A plurality of lighting parts 3 respectively provided with a focusing means 16 at a light irradiation side of a linear light source 14 wherein a number of illuminants are linearly arranged, respectively irradiate the approximately same part of an inspection object, and the illuminants VL1, VR1 of the plurality of lighting parts 3 are arranged in a such manner that the positions of the inspection object irradiated by each of illuminants VL1 of the lighting part 3 and the positions of the inspection object irradiated by each of illuminants VR1 are different from each other in the longitudinal direction of a linear group of illuminants.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention by the reflected light which irradiated light and has been reflected in the product which is an inspection object at works etc. Others [inspection / the appearance of a product, or / of a blemish], Others [lighting system / which is used when inspecting the quality of soldering of the electronic parts mounted on the printed circuit board / checking], The inspection object which becomes with transparence or a translucent ingredient, for example, plastics, paper, etc., is irradiated, and it is related with the checking lighting system used in order for the transmitted light which has penetrated the inspection object to perform foreign matter detection etc.
[0002]
[Description of the Prior Art] In order to explain plainly as the above-mentioned checking lighting system, it explains using drawing 1 of the invention in this application. That is, each three train of the linear light source 14 which comes to arrange a majority of light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 along with the longitudinal direction (it sets to drawing and is perpendicularly to space) of Substrates 15L and 15R is arranged to these substrates 15L and 15R. these three linear light sources 14, 14, and 14 — the 1st lighting sections 3 and 3 of a Uichi Hidari pair which come to arrange the cylindrical lenses 16, 16, and 16 for making band-like condense to each optical exposure side through support plate 16A Even when a control surface is not a flat like the part which irradiated light from across to the inspection object, for example, was soldered, it enables it to inspect by applying light certainly by arranging so that Ha's character type may be made in side view. And since the installation location in the longitudinal direction of the light emitting diodes VR1, VR2, and VR3 which constitute the 1st lighting section 3 of another side was the same when the 1st lighting section 3 of another side is seen from the installation location in the longitudinal direction of the light emitting diodes VL1, VL2, and VL3 which constitute one [said] 1st lighting section 3, and one [this] 1st lighting section 3, un-arranging [which is described below] had occurred.
[0003]
[Problem(s) to be Solved by the Invention] That is, since according to the above-mentioned configuration the light H1 from one light emitting diodes VL1, VL2, and VL3 of each and the light H2 from each light emitting diodes VR1, VR2, and VR3 of another side corresponding to this irradiate the same part as shown in drawing 14 , As shown in drawing, the part B (drawing two upper and lower sides between light) which is not illuminated among the light of the light emitting diode which adjoins each other by the longitudinal direction and which becomes dark occurred, and inspection in the part was what cannot be performed good. In addition, even if the clearance between adjacent light emitting diodes had arranged much light emitting diodes in the dense small condition as much as possible, it cannot cancel said un-arranging and there was room of an improvement.
[0004] The place which this invention tends to solve in view of the above-mentioned situation is in the point of offering the checking lighting system which can be equally illuminated in every part, without the part which becomes dark occurring.

[0005]
[Means for Solving the Problem] This invention two or more each of the lighting section which comes to arrange a condensing means to the optical exposure side of the linear light source by which many emitters have been arranged at the line for the above-mentioned technical-problem solution It irradiates to the same part mostly. an inspection object — each location where each emitter of this lighting section irradiates an inspection object — this — each emitter of two or more of these lighting sections has been arranged so that it may differ in the longitudinal direction of the linear emitter group which each location where each emitter of another lighting section irradiates an inspection object irradiates, and the checking lighting system was constituted. therefore, it is condensed by condensing means, such as a cylindrical lens, and the light from two or more lighting sections is changed into a band-like light — having — an inspection object — the same part irradiates mostly. And the light from each emitter of two or more of said lighting sections is irradiated as shown in drawing 4 . that is, by irradiate, after the light H2 from each emitter of another lighting section have overlap in part between the almost circular light H1 from each emitter of the specific lighting section, and H1, it can constitute so that it become an almost band-like light (range surround by the dot), and the up-and-down dark parts B and B showed by drawing 14 may be abolish and brightness may become almost equal in every part. H3 and H4 which are shown in drawing 4 and drawing 14 are a light generated on both the outsides of said light H1 and H2, and they will be inspected by the band-like light which does not inspect in this range and is drawn by said light H1 and H2 in fact. In addition, the light which reflected said inspection object is picturized with image pick-up means, such as for example, a line sensor camera, and it constitutes so that the image processing system which processes the picturized image may be prepared and it may inspect automatically, and also depending on the case, it can also inspect by viewing from the upper part of a half mirror. Although it is the optimal in what inspects an inspection object by the reflected light, the checking lighting system of this invention can be used, also when the light which irradiated the inspection object which becomes with paper, plastics, etc. penetrates an inspection object and performs foreign matter detection etc. from the transmitted light. although the advantage which shows 3 successive installation beam thing for the lighting section, and aims at increase of the quantity of light compared with the thing of one train or two trains is in both sides in drawing 1 on both sides of the perpendicular T which becomes perpendicular to the control surface (front face) of an inspection object, respectively — one train — 2 successive-installation **** operation can also be carried out, four or more trains are established, and you may make it increase the quantity of light further Although the effectiveness that brightness becomes equal in every part of this longitudinal direction by arranging all emitters can be further heightened so that it may differ by the longitudinal direction of the emitter group by which the exposure location of each emitter of all the lighting sections has been arranged in said lighting section at the line at two or more successive installation **** case All emitters may be arranged so that it may differ from the exposure location of each emitter of other lighting sections with which only the exposure location of each emitter of a part of lighting sections remains. As a means to change said exposure location, the pitch of each illuminants of all the lighting sections is set up identically. So that the exposure locations of each emitter of the part of all the lighting sections or all the lighting sections may differ by emitter orientation (longitudinal direction of said emitter group) shift and arrange a part or all the lighting sections, or You may make it the exposure locations of each illuminant of a part or all the lighting sections differ by other exposure locations and illuminant orientation of each illuminant of the lighting section by changing the pitch of each illuminants of the specific lighting section with the pitch of each illuminants of other lighting sections.
[0006] It arranges so that two or more each of said lighting section may be distributed to both sides on both sides of the perpendicular which becomes perpendicular to the front face of an inspection object and may be irradiated from [of this inspection object / to the same part / mostly different] across.
[0007] The lighting section which was able to be distributed to the one side of two or more lighting sections distributed to said both sides can increase the quantity of light by constituting

said linear light source from an arranged thing of an inspection object so that it may irradiate to the same part mostly.

[0008] So that each illuminant which constitutes said other specific remaining linear light sources may be located among each illuminants which constitute the pitch of each illuminant which constitutes said linear light source in the same pitch in every linear light source, and constitute said specific linear light source By the ability shifting the location of the specific linear light source of this everything but the remainder in the direction of [when seeing the specific linear light source of this everything but the remainder from this specific linear light source] to this specific linear light source The exposure location to the inspection object from each emitter of the lighting section located in one side as mentioned above and the exposure location to the inspection object from each emitter of the lighting section located in the other side are changed in the orientation of an emitter. It will irradiate, after a part of light from each emitter of the lighting section has overlapped as mentioned above.

[0009] It not only becomes advantageous, but compared with the case where various lamps constitute, in power consumption and an exoergic side, a life is long by leaps and bounds, and there is an advantage with a slow degradation speed by constituting said illuminant from a light emitting diode or a chip mold light emitting diode. In addition, there is an advantage which the case where the light emitting diode of a shell mold is used can make condense effectively with a condensing means compared with the case of a chip mold light emitting diode.

[0010] Since light is perpendicularly irradiated to the inspection object caudad located through the clearance formed among the lighting sections distributed to said both sides, the 2nd lighting section which the emitter of a large number which intervene and irradiate a condensing means at the half mirror arranged in the upper part part of this clearance becomes from the 2nd linear light source arranged at the line almost parallel to the orientation of said emitter is arranged. By constituting as mentioned above, it is condensed by condensing means, such as a cylindrical lens, and the light from the 2nd lighting section is changed into a band-like light, is irradiated from a perpendicular direction to an inspection object, and even when a flat [a control surface], it can conduct good inspection.

[0011] Two or more each of the lighting section from which many emitters arrange and come to constitute a condensing means in the optical exposure side of the linear light source arranged at the line It arranges so that it may distribute to both sides on both sides of the perpendicular which becomes perpendicular to the front face of an inspection object and may irradiate from [of an inspection object / to the same part / mostly different] across. Since light is perpendicularly irradiated to the inspection object caudad located through the clearance between the lighting sections distributed to said both sides The 2nd lighting section which the emitter of a large number which intervene and irradiate a condensing means at the half mirror arranged in the upper part part of this clearance becomes from the 2nd linear light source arranged at the line almost parallel to the orientation of said emitter is arranged. Each emitter of this 1st lighting section and each emitter of this 2nd lighting section are arranged so that each location where each emitter of said specific 1st lighting section irradiates an inspection object at least may differ from each location where each emitter of said 2nd lighting section irradiates an inspection object. A checking lighting system can also be constituted. Therefore, by changing the exposure location to the inspection object from each emitter of a part (specification) or all the lighting sections, and the exposure location to the inspection object from each emitter of the 2nd lighting section, after a part of light from each emitter of the lighting section and light from each emitter of the 2nd lighting section have overlapped, it will irradiate. Moreover, by changing the exposure location to the inspection object from each emitter of a part of (specification) lighting sections, and the exposure location to the inspection object from each emitter of the remaining lighting section, after a part of light from each emitter of the lighting section has overlapped, it will irradiate. Moreover, after a part of light from each emitter of the 2nd lighting section has overlapped two or more successive installation **** case by changing an exposure location [as opposed to the inspection object from each emitter of a part of 2nd lighting sections for the 2nd lighting section], and the exposure location to the inspection object from each emitter of the remaining 2nd lighting section, it will irradiate.

[0012] The diffusion plate for diffusing the light from said emitter between said condensing means and inspection objects is arranged. Although a strong light (light near the optical axis of an emitter) reflected regularly from the emitter of the specific lighting section among the light from the emitter of two or more lighting sections with which include angles differ on the relation made to condense with a condensing means can be incorporated for the image pick-up means In spite of being unable to incorporate a strong light reflected regularly from the emitter of other another lighting sections for said image pick-up means but illuminating in two or more lighting sections, the light incorporated to an image pick-up means will become dark. Then, since the light from the emitter of other another lighting sections which was not able to be incorporated by forming a diffusion plate as mentioned above can also be incorporated for an image pick-up means, light incorporated to an image pick-up means can be made bright.
[0013] Two or more each of said lighting section is arranged on both sides on both sides of the perpendicular which becomes perpendicular to the front face of an inspection object in the condition that a clearance occurs, among these lighting sections, and the reflected light which it irradiated from said lighting section and reflected the front face of an inspection object is constituted possible [recognition] through the clearance between said lighting sections.
[0014] Many emitters may arrange a condensing means to the optical exposure side of the linear light source arranged at the line, the diffusion means for making the orientation of an emitter diffuse the light from said linear light source may be established the front or behind the condensing means, and a checking lighting system may be constituted. By establishing a diffusion means the front or behind a condensing means as mentioned above Before the light from each emitter is condensed, or after being condensed, it is spread in the orientation of an emitter. For example, when copying the direct light source as a back light, or making the glossy surface of the inspection object which has a glossy surface carry out specular reflection and seeing, the ball of emitters, such as light emitting diode, can cancel the phenomenon in which light will break [between direct vanity, an emitter, and emitters] off. Although the light h in the condition of the ball of light emitting diode 25 having not appeared directly, and having been formed in band-like can specifically be seen if the light h which irradiated paper 1 and has been reflected from light emitting diode 25 is seen with a naked eye I when the inspection object 1 is paper as shown in drawing 20 (a) As shown in drawing 20 (c), when the inspection object 1 is a mirror plane When it sees with a naked eye I, the ball of light emitting diode 25 can cancel this by using a diffusion means as mentioned above by between direct vanity, light emitting diode 25, and light emitting diodes 25 generating the phenomenon in which light will break off. And as shown in drawing 20 R> 0 (b), when copying the direct light source as a back light, the ball of the light emitting diode 25 shown by drawing 20 (c) will be visible to band-like [even a grain appears / with which not a condition but these balls were connected into small pieces] by using the diffusion means 28 which consists of a diffusion plate etc. In this case, the lighting section may be single, and in order to raise brightness, more than one can be prepared and it can also carry out. As said diffusion means, a majority of heights of various kinds of configurations along the one direction which intersects perpendicularly with the orientation of an emitter can be formed in a front face along with the orientation of this emitter, or it is what equipped the interior of the transparent body with diffusion members, such as an optical fiber, and can constitute. In addition, drawing 20 (a), (b), and (c) omit a condensing means.
[0015]
[Embodiment of the Invention] The checking lighting system which can be illuminated in order to inspect surface irregularity, a surface soldered part which is not illustrated of a printed circuit board 1 as an inspection object to drawing 1 is shown. This checking lighting system arranges two (you may be three or more) of the 1st lighting sections 3 which are the lighting section which distributes to both sides on both sides of the perpendicular T which becomes perpendicular to the flat control surface (front face) of a printed circuit board 1, and irradiates in the casing 2 of a cube type by the shape of a rectangle by which the lower part was opened wide from [of a printed circuit board 1 / to the same part / mostly different] across. Although the lighting system for surface analyses which inspects by here incorporating the reflected light which reflected the front face of an inspection object is shown, you may be the checking lighting

system used when incorporating the transmitted light which penetrated the inspection object which becomes with transparence or a translucent ingredient and performing foreign matter detection etc. An image processing is carried out with the image processing system which is not illustrating the image which caught the reflected light reflected in said inspection object with the line sensor camera (not shown) arranged above long hole 5A (refer to drawing 8) of the superior lamella section 5, it projects on a monitor etc. and human being may be made judge the quality of the image by computer, or to judge a quality. In addition, you may be the configuration of omitting said line sensor camera depending on the case, and inspecting an inspection object by viewing.
[0016] As shown in drawing 1 , the clearance S between the dimensions of the almost same magnitude as the width of face (magnitude of the direction which become perpendicular to a longitudinal direction) of said long hole 5A be opened, and said 1st lighting sections 3 and 3 be arranged, and they be arranged so that Ha's character type may be made in the inclination posture, i.e., side view, in which the side which separate from Clearance S be located more nearly caudad. Since each of said 1st lighting sections 3 and 3 is the same configuration, it explains only one 1st lighting section 3. Said 1st lighting section 3 is substrate 15L (in other substrate 15R) about the 1st linear light source 14, 14, and 14 of three trains arranged at the line in the direction in which space and each of three light emitting diodes VL1, VL2, and VL3 which set predetermined spacing in the direction of slant, and were arranged in it cross at right angles in drawing 1 . [many] VR1, VR2, and VR3 are attached — ****, while attaching The cylindrical lenses (as long as it can make it condense, what kind of thing may be used) 16, 16, and 16 as three condensing means are arranged through transparent support plate 16A almost in parallel with these light emitting diodes VL1, VL2, and VL3 to the light side of each [these] 1st linear light source 14. It is constituted. In addition, what really formed said three cylindrical lenses 16, 16, and 16 and said support plate 16A may be used.
[0017] As shown in drawing 2 , to optical-axis 13A of each light emitting diode VL2 of the 1st linear light source 14 arranged in the center of the 1st linear light source 14, 14, and 14 of three trains It changes into the condition of having made the core of said cylindrical lens 16 arranged corresponding to this agreeing. As opposed to the distance (the 1st linear light source 14, distance between 14 (pitch)) P1 to the 1st linear light source VL1 and VL3 of two trains located in both sides to the 1st linear light source 14 located in said center By making small distance (distance between a cylindrical lens 16 and 16 (pitch)) P2 to the cylindrical lenses 16 and 16 located in both sides to the cylindrical lens 16 located in said center Although it enables it to make one place condense the opticals axis 13A, 13A, and 13A from three cylindrical lenses 16, 16, and 16 Each location of the cylindrical lenses 16, 16, and 16 to light emitting diodes VL1, VL2, and VL3 is made the same. By changing the include angle of the light emitting diodes VL1 and VL3 and the cylindrical lenses 16 and 16 which are located in both sides to light emitting diode VL2 and the cylindrical lens 16 which are located in the center You may enable it to make one place condense the opticals axis 13A, 13A, and 13A from three cylindrical lenses 16, 16, and 16. In this case, it is separate and substrate 15L to light emitting diodes VL1, VL2, and VL3 may be constituted.
[0018] The arrangement condition of the light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 attached in the same installation location in said same pitch is shown in drawing 3 , and the condition of the light by these light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 is shown in drawing 5 . It is got blocked. Among the light H1 and H1 to the inspection object from the light emitting diodes VL1, VL2, and VL3 which adjoin each other by the longitudinal direction of the 1st linear light source 14 of three trains attached in substrate 15L (it arranges to the down side in drawing 3) located in left-hand side So that the light H2 to the inspection object from each light emitting diodes VR1, VR2, and VR3 arranged along with the longitudinal direction of the 1st linear light source 14 of three trains attached in substrate 15R (it arranges to the up side in drawing 3) located in right-hand side may be overlapped and located You make it located in the location to which the location of right-hand side substrate 15R was moved in the direction of [when seeing substrate 15R of another side from one substrate 15L] by the half-pitch of the pitch (spacing) of a light emitting diode 13 and 13 comrades to left-hand side substrate 15L. He is trying for the light irradiated by band-like to become the uniform quantity of light which does

not have a dark part in every part. Although the location of the substrates 15L and 15R of said right and left was shifted in drawing 3 By what the attaching position of the light emitting diodes VL1, VL2, and VL3 arranged in one substrate 15L and the attaching position of the light emitting diodes VR1, VR2, and VR3 arranged in substrate 15R of another side are changed for (it shifts) You may constitute so that the light irradiated by band-like as mentioned above may become the uniform quantity of light which does not have a dark part in every part. By a diagram, although the 1st linear light source 14 of three trains is shown, the 1st linear light source of one train, two trains, or four trains or more can also be established and carried out. Moreover, the 1st linear light source 14 of two or more trains is attached in the same substrate 15L or 15R, and also it can also attach and carry out to the substrate only for single tiers every.

[0019] It can arrange and said light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 can also be carried out, as shown in drawing 4 . Each of light emitting diodes VL1, VL2, and VL3 is attached in substrate 15L (in drawing 4 , it arranges to the down side) located in said left-hand side so that it may differ in the direction which is the same pitch PA and intersects perpendicularly with the orientation (longitudinal direction of a light emitting diode group) of each light emitting diode. Moreover, light emitting diodes VR1, VR2, and VR3 are attached in substrate 15R (in drawing 4 , it arranges to the up side) located in said right-hand side so that it may differ in the direction which is the same pitch PA and intersects perpendicularly with the orientation of each light emitting diode. In addition, although light emitting diodes VL2 and VR3 are the same locations in the direction which intersects perpendicularly with the longitudinal direction of the orientation light emitting diode group of light emitting diode, it can also carry out by making it differ. By arranging light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 as mentioned above When the right-hand side light emitting diodes VR1, VR2, and VR3 are seen from the left-hand side light emitting diodes VL1, VL2, and VL3 Although a part of both installation location overlaps, it will be in the condition that most differ. A part of light when irradiating these light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 can make it overlap, for example, enables it to make it overlap between VL2, VL3, or VL3 and VR1. In addition, although drawing 4 R> 4, drawing 11 mentioned later, and drawing 12 showed the condition of having vacated greatly between light emitting diodes in order to make arrangement of light emitting diode intelligible, with the naked eye, it will be arranged like drawing 3 in fact at the dense condition.

[0020] By forming and carrying out the diffusion plate K with which the through tube K1 for passing the reflected light from a printed circuit board 1 was formed in the core in the opening of said casing 2, as shown in drawing 6 The exposure nonuniformity of the light from light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 can be eased, and a printed circuit board 1 irradiates, and you may constitute so that this reflected light can be incorporated as much as possible for an upper image pick-up means along with Perpendicular T. When it assumes that brightness falls in one half mostly by forming said diffusion plate K, in the light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 of six trains From the ability of this light reflected as mentioned above to be incorporated as much as possible for an upper image pick-up means along with Perpendicular T, although only the brightness of the light of the light emitting diode of three trains is obtained The direction at the time of forming the diffusion plate K in fact becomes advantageous in exposure nonuniformity and the brightness of light incorporated compared with the case where the diffusion plate K is not formed. Moreover, in exposure nonuniformity and the brightness of light incorporated, it can be made still more advantageous by making said diffusion plate K thin and bringing close to a printed circuit board 1 as much as possible. And although a part of both installation location overlaps when the right-hand side light emitting diodes VR1, VR2, and VR3 are seen as mentioned above from the left-hand side light emitting diodes VL1, VL2, and VL3, in said exposure nonuniformity, it becomes still more advantageous by considering as the condition that most differ. Although the diffusion plate K has been horizontally arranged to the light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 arranged aslant [said], you may arrange aslant so that the diffusion plate K may become parallel to light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3.

[0021] If the difference when having not formed the case where said diffusion plate K is formed, and the diffusion plate K is explained briefly As shown in drawing 7 (a), the image pick-up means

23 is formed in the location which leaned only the include angle theta to the left-hand side of drawing to the perpendicular T which becomes perpendicular to the inspection object which is not illustrated. Two trains of the linear light source by which much light emitting diodes 22 and 22 were attached in the right-hand side of drawing in the perpendicular direction to space like the above (although two trains are shown here in order to simplify explanation) one train or three trains or more — you may be — what has arranged and has arranged the cylindrical lens 16 to the exposure side side of these linear light sources is shown. In drawing, the right-hand side linear light source arranges in the location which leaned only the include angle theta to right-hand side to said perpendicular T. Therefore, although only the direct reflected light (specular reflection light) from the right-hand side light emitting diode 22 is incorporated by the image pick-up means 23 among the light irradiated by the flat control surface of an inspection object from each light emitting diode 22 and 22, the direct reflected light (specular reflection light) from the left-hand side light emitting diode 22 cannot be incorporated. Therefore, by being able to incorporate only the light from one linear light source for the image pick-up means 23, but arranging the diffusion plate K, as shown in drawing 7 (b) to becoming dark, the light from all linear light sources can be made to reflect in the image pick-up means 23 not a little, and it can avoid becoming dark like drawing 7 (a). In addition, if the number of a linear light source increases, the effectiveness by forming the diffusion plate K indeed will become remarkable. Drawing 5 , drawing 13 , and drawing 14 do not show the direct reflected light (specular reflection light) of a linear light source, and show the scattered light scattered about on the front face of a printed circuit board 1.

[0022] Although there is an advantage which can attain a miniaturization by constituting a checking lighting system only from the 1st lighting sections 3 and 3 in drawing 1 , the 2nd lighting section 4 may be formed in drawing 8 - drawing 10 . This checking lighting system contains two (you may be three or more) of the 1st lighting sections 3 and the 2nd lighting section 4 which are the lighting section which distributes to both sides on both sides of the perpendicular T which becomes perpendicular to the control surface of a printed circuit board 1, and irradiates in the casing 2 of a cube type from [of a printed circuit board 1 / to the same part / mostly different] across, and consists of shape of a rectangle by which the lower part was opened wide. said casing 2 — method ** of order — although wrap right-and-left Itabe 6 and 7 and order are consisted of wrap order Itabe 8 and 9 in the superior lamella section 5 by which checking long long hole 5A was mostly formed in the center at the longitudinal direction, and right and left, you may be things other than the configuration shown in drawing. 10, 11, and 12 which are shown in drawing 8 and drawing 9 are a cable for supplying power to said 1st lighting sections 3 and 3 and the 2nd lighting section 4. Here, although the thing equipped with the 1st lighting sections 3 and 3 and the 2nd lighting section 4 of a pair is shown, the 2nd lighting section 4 is omitted, and it is what formed only the 1st lighting sections 3 and 3 of a pair, and you may constitute. An image processing is carried out with the image processing system which is not illustrating the image which caught the reflected light reflected in said inspection object like the above-mentioned with the line sensor camera (not shown) arranged above long hole 5A of the superior lamella section 5, it projects on a monitor etc. and human being may be made judge the quality of the image by computer, or to judge a quality. In addition, you may be the configuration of omitting said line sensor camera depending on the case, and inspecting an inspection object by viewing.

[0023] As shown in drawing 11 , each of light emitting diodes VL1, VL2, and VL3 is attached in substrate 15L (in drawing 11 , it arranges to the down side) located in said left-hand side so that it may differ in the direction which is the same pitch PA and intersects perpendicularly with the orientation of each light emitting diode. Moreover, light emitting diodes VR1, VR2, and VR3 are attached in substrate 15R (in drawing 11 , it arranges to the up side) located in said right-hand side so that it may differ in the direction which is the same pitch PA and intersects perpendicularly with the orientation of each light emitting diode. In addition, although light emitting diodes VL2 and VR3 are the same locations in the direction which intersects perpendicularly with the orientation of light emitting diode, it can also carry out by making it differ. By arranging light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 as mentioned above When the right-hand side light emitting diodes VR1, VR2, and VR3 are seen from the left-hand

side light emitting diodes VL1, VL2, and VL3 Although a part of both installation location overlaps, it will be in the condition that most differ. A part of light when irradiating these light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 can make it overlap, for example, enables it to make it overlap between VL2, VL3, or VL3 and VR1. Although 19 shown in drawing 11 shows the light emitting diode of said 2nd lighting section 4 (it displays with the square in order to distinguish from the light emitting diode of the 1st lighting section easily) and makes it the same pitch as said light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3, it may be a different pitch. Moreover, by drawing 12 , although the light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 of said 1st lighting section 3 are the same as that of drawing 11 , the case where only the installation location of the light emitting diode 19 of said 2nd lighting section 4 is changed is shown (in order to distinguish from the light emitting diode of the 1st lighting section easily, it displays with the square).

[0024] The installation location of light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 is identically set up towards intersecting perpendicularly with the orientation of light emitting diode so that the exposure location of said all light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 may become the same part. You may arrange and carry out so that the exposure location of said light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 may differ from the exposure location of the light emitting diode 19 of said 2nd lighting section 4 in the orientation of light emitting diode. In this case, as shown in drawing 13 , it will irradiate, after the light H5 of light emitting diode 19 has overlapped between H1 (H2), the light H1 (H2) of light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3, and, and can control that the part which becomes dark occurs.

[0025] Said 2nd lighting section 4 is constituted so that light may be perpendicularly irradiated to the inspection object 1 caudad located through the 1st lighting section 3 of said pair, and the clearance S between three comrades. Specifically As shown in drawing 8 – drawing 10 , the upper part part of Clearance S, It is a cylindrical lens (it is the thing which can make it condense) as a condensing means to the half mirror 17 which will have been arranged in the lower part part of long hole 5A if put in another way, and this half mirror 17. If it is, much light emitting diodes 19 with which anythings intervene and irradiate good 18 consist of the 2nd linear light source 21 arranged through a substrate 20 at the line almost parallel to the orientation of said light emitting diode 13. By a diagram, although only the single tier is forming and carrying out light emitting diode 19, two or more successive installation **** operation can also be carried out.

[0026] Although it is effective when the case where the thing of a shell mold is used makes it condense as said light emitting diode 13, you may be the light emitting diode of the chip mold which can raise packaging density.

[0027] Said checking lighting system can also be constituted as shown in drawing 14 (a) and (b). That is, the substrate 26 with which predetermined spacing was kept on the straight line, and much light emitting diodes [a majority of] 25 were supported inside [one side was opened wide] the casing 24 of a core box, The diffusion plate 28 as a diffusion means for making the orientation X of light emitting diode 25 diffuse the light from said light emitting diode 25 (you may constitute from a transparent acrylic board etc. and the thing on a sheet may be used), In order to make the light diffused with this diffusion plate 28 condense, the cylindrical lens 27 as a condensing means located in the open end of casing 24 is arranged. Although the diffusion plate 28 is here arranged where a field is approached or contacted after a back [of a cylindrical lens 27] 25, i.e., light emitting diode, side (back) As shown in drawing 15 , they are locations (although drawing shows three locations in all including the rear face) other than the after (back) side of the back locations by the side of light emitting diode 25. except the location shown in drawing — ****** — the diffusion plate 28 may be arranged, and the diffusion plate 28 can be arranged ahead of a cylindrical lens 27, it can also carry out, and you may arrange to both the front of a cylindrical lens 27, and back depending on the case. As for the permeability of said diffusion plate 28, it is desirable that setting up to 80% or more causes the fall of the brightness by transparency of light few.

[0028] As shown in drawing 16 , said diffusion plate 28 is that by which the cross-section configuration formed a majority of semicircle-like heights 28a in the front face (top face) as for

which the light from said light emitting diode 25 carries out incidence mostly along with the orientation X of said light emitting diode 25, and is constituted. And said each heights 28a is constituted by the configuration long in the direction (direction which intersects perpendicularly with space) which intersects perpendicularly with the orientation X of said light emitting diode 25. Thus, the light (light which carries out incidence from a lower part in a drawing) which has carried out incidence to the constituted diffusion plate 28 from said light emitting diode 25 diffuses in said orientation X from a front face. As a configuration of said irregularity, as shown in drawing 17 , a cross-section configuration may be a configuration to which wave-like, shape of i.e., semicircle, heights 28A and semicircle-like crevice 28B are located in said orientation X by turns.

[0029] As said diffusion means, as mentioned above on the front face (optical incidence side face) of the diffusion plate 28 Although a majority of heights of various kinds of configurations along the one direction which intersects perpendicularly with the orientation X of light emitting diode 25 were formed along with the orientation X of this light emitting diode 25, as it is shown in others and drawing 18 (a) The diffusion plate 28 may consist of things which regular intervals were put [things] on the interior of the transparent body, and made it equipped with the diffusion members [being cylindrical (what kind of configuration being sufficient as a configuration)] 29, such as an optical fiber, along with the orientation X of said light emitting diode 25. Moreover, make the interior of the transparent body equipped with one more kind (for you to be two or more kinds) from which the diameter other than the diffusion member 29 shown by drawing 18 (a) differs in drawing 18 (b). What it was made to be equipped with two kinds of diffusion members 29 and 30 by turns along with the orientation X of said light emitting diode 25, and constituted the diffusion plate 28 is shown. That is, in drawing 18 (c) The diffusion member 31 which is in the condition to which the part projected the diffusion members [being cylindrical (what kind of configuration being sufficient as a configuration)] 31, such as an optical fiber, on the front face (top face), and adjoins each other, and the thing which was made to have in the dense condition that there is no clearance, among 31, and constituted the diffusion plate 28 are shown.

[0030] Thus, by using the diffusion plate 28 of drawing 16 - drawing 18 , as the light h irradiated by the inspection object 1 through the diffusion plate 28 and a cylindrical lens 27 from said light emitting diode 25 shows drawing 19 , it will be spread. And when copying the direct light source as a back light, or making the glossy surface of the inspection object 1 which has a glossy surface carry out specular reflection and seeing as shown in drawing 20 (c) as shown in drawing 20 (b), the ball of light emitting diode 25 can cancel the phenomenon in which light will break [between direct vanity, light emitting diode 25, and light emitting diodes 25] off. In addition, it is shown in drawing 20 (c) as an example of a comparison irradiated without using said diffusion plate 28. Moreover, said diffusion plate (means) 28 can also be attached and carried out to the checking lighting system of drawing 1 or drawing 8 . In the case of drawing 1 or drawing 8 , as mentioned above In the longitudinal direction of the linear light emitting diode group which each location where each light emitting diodes VL1, VL2, and VL3 of the lighting section 3 irradiate the inspection object 1, and each location where each light emitting diodes VR1, VR2, and VR3 of another lighting section 3 irradiate the inspection object 1 irradiate Since each light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 of two or more of these lighting sections 3 and 3 are arranged so that it may differ A dark part does not occur, there is an advantage (effectiveness) that it can illuminate equally in every part, and the advantage can be made much more remarkable according to the synergistic effect with the diffusion of the diffusion plate 28.

[0031]

[Effect of the Invention] According to invention of claim 1, when a control surface irradiates band-like to the inspection object which is not a flat by the light from two or more lighting sections, the checking lighting system with which the thing of the configuration of the part soldered especially can also conduct good inspection can be offered. And the checking lighting system which a dark part does not generate and can be equally illuminated in every part only by changing the exposure location from two or more lighting sections can be constituted. Moreover, when incorporating the transmitted light which penetrated the inspection object and conducting

dust particle inspection etc., said same effectiveness can be acquired. Moreover, many emitters arrange a condensing means to the optical exposure side of the linear light source arranged at the line like claim 10. By establishing the diffusion means for making the orientation of an emitter diffuse the light from a linear light source the front or behind the condensing means When making the glossy surface of the inspection object which copies the direct light source as a back light, or has a glossy surface carry out specular reflection and seeing, The ball of emitters, such as light emitting diode, can acquire the effectiveness which can cancel the phenomenon in which light will break [between direct vanity, an emitter, and emitters] off, that is, a dark part does not generate and can be equally illuminated in every part like claim 1. Moreover, it is unnecessary to change arrangement of an emitter like claim 1, and there is an advantage which can do said effectiveness so to the existing checking lighting system by the easy reconstruction which attaches a diffusion means.

[0032] According to invention of claim 3, the quantity of light can be increased by constituting said linear light source from an arranged thing of an inspection object so that it may irradiate to the same part mostly, when the lighting section which was able to be distributed to the one side of two or more lighting sections distributed to both sides inspects the small blemish which is hard to find it, it becomes advantageous, and it can aim at expansion of an inspection object.

[0033] It not only becomes advantageous, but compared with the case where various lamps constitute, in power consumption and an exoergic side, a life is long by leaps and bounds, and, according to invention of claim 5, there is an advantage with a slow degradation speed by constituting an illuminant from a light emitting diode or a chip mold light emitting diode. And in the case of chip mold light emitting diode, packaging density can be raised compared with the light emitting diode of a shell mold, and the effectiveness which can make luminous intensity homogeneity in every part can be further raised to it.

[0034] According to invention of claim 6, even if it is the inspection object of what kind of configuration by being able to conduct good inspection and using together with the lighting section of said pair even when a flat [a control surface] since it can irradiate from a perpendicular direction to an inspection object by arranging the 2nd lighting section, the checking lighting system which can conduct good inspection can be offered. Moreover, it becomes effective, when incorporating the transmitted light which penetrated the inspection object and conducting dust particle inspection etc.

[0035] According to invention of claim 7, by arranging the 2nd lighting section like claim 5 By being able to conduct good inspection, even when a flat [a control surface], and using together with the lighting section of said pair, since it can irradiate from a perpendicular direction to an inspection object Being able to conduct good inspection, even if it is the inspection object of what kind of configuration Or it changes arrangement of each emitter of the lighting section, change arrangement of each emitter of the 2nd lighting section, or by changing arrangement of each emitter of the lighting section, and each emitter of the 2nd lighting section Like claim 1, a dark part does not occur, it can illuminate equally in every part, and there is an advantage which can raise the degree of freedom of a design of a checking lighting system. Moreover, it becomes effective, when incorporating the transmitted light which penetrated the inspection object and conducting dust particle inspection etc.

[0036] According to invention of claim 8, by arranging the diffusion plate for diffusing the light from said emitter, the light from the lighting section which cannot be incorporated can also be incorporated between a condensing means and an inspection object, and the advantage which can raise inspection precision is in it. The quantity of light which can be incorporated the more the more there is much number of said lighting section can be increased.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention by the reflected light which irradiated light and has been reflected in the product which is an inspection object at works etc. Others [inspection / the appearance of a product, or / of a blemish], Others [lighting system / which is used when inspecting the quality of soldering of the electronic parts mounted on the printed circuit board / checking], The inspection object which becomes with transparence or a translucent ingredient, for example, plastics, paper, etc., is irradiated, and it is related with the checking lighting system used in order for the transmitted light which has penetrated the inspection object to perform foreign matter detection etc.

PRIOR ART

[Description of the Prior Art] In order to explain plainly as the above-mentioned checking lighting system, it explains using drawing 1 of the invention in this application. That is, each three train of the linear light source 14 which comes to arrange a majority of light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 along with the longitudinal direction (it sets to drawing and is perpendicularly to space) of Substrates 15L and 15R is arranged to these substrates 15L and 15R. these three linear light sources 14, 14, and 14 — the 1st lighting sections 3 and 3 of a Uichi Hidari pair which come to arrange the cylindrical lenses 16, 16, and 16 for making band-like condense to each optical exposure side through support plate 16A Even when a control surface is not a flat like the part which irradiated light from across to the inspection object, for example, was soldered, it enables it to inspect by applying light certainly by arranging so that Ha's character type may be made in side view. And since the installation location in the longitudinal direction of the light emitting diodes VR1, VR2, and VR3 which constitute the 1st lighting section 3 of another side was the same when the 1st lighting section 3 of another side is seen from the installation location in the longitudinal direction of the light emitting diodes VL1, VL2, and VL3 which constitute one [said] 1st lighting section 3, and one [this] 1st lighting section 3, un-arranging [which is described below] had occurred.

[Translation done.]

EFFECT OF THE INVENTION

(It is) effective and the advantage can be made much more remarkable according to the synergistic effect with the diffusion of the diffusion plate 28.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] That is, since according to the above-mentioned configuration the light H1 from one light emitting diodes VL1, VL2, and VL3 of each and the light H2 from each light emitting diodes VR1, VR2, and VR3 of another side corresponding to this irradiate the same part as shown in drawing 14 , As shown in drawing, the part B (drawing two upper and lower sides between light) which is not illuminated among the light of the light emitting diode which adjoins each other by the longitudinal direction and which becomes dark occurred, and inspection in the part was what cannot be performed good. In addition, even if the clearance between adjacent light emitting diodes had arranged much light emitting diodes in the dense small condition as much as possible, it cannot cancel said un-arranging and there was room of an improvement.
[0004] The place which this invention tends to solve in view of the above-mentioned situation is in the point of offering the checking lighting system which can be equally illuminated in every part, without the part which becomes dark occurring.

[Translation done.]

MEANS

[Means for Solving the Problem] This invention two or more each of the lighting section which comes to arrange a condensing means to the optical exposure side of the linear light source by which many emitters have been arranged at the line for the above-mentioned technical-problem solution It irradiates to the same part mostly. an inspection object — each location where each emitter of this lighting section irradiates an inspection object — this — each emitter of two or more of these lighting sections has been arranged so that it may differ in the longitudinal direction of the linear emitter group which each location where each emitter of another lighting section irradiates an inspection object irradiates, and the checking lighting system was constituted. therefore, it is condensed by condensing means, such as a cylindrical lens, and the light from two or more lighting sections is changed into a band-like light — having — an inspection object — the same part irradiates mostly. And the light from each emitter of two or more of said lighting sections is irradiated as shown in drawing 4 . that is, by irradiate, after the light H2 from each emitter of another lighting section have overlap in part between the almost circular light H1 from each emitter of the specific lighting section, and H1, it can constitute so that it become an almost band-like light (range surround by the dot), and the up-and-down dark parts B and B showed by drawing 14 may be abolish and brightness may become almost equal in every part. H3 and H4 which are shown in drawing 4 and drawing 14 are a light generated on both the outsides of said light H1 and H2, and they will be inspected by the band-like light which does not inspect in this range and is drawn by said light H1 and H2 in fact. In addition, the light which reflected said inspection object is picturized with image pick-up means, such as for example, a line sensor camera, and it constitutes so that the image processing system which processes the picturized image may be prepared and it may inspect automatically, and also depending on the case, it can also inspect by viewing from the upper part of a half mirror. Although it is the optimal in what inspects an inspection object by the reflected light, the checking lighting system of this invention can be used, also when the light which irradiated the inspection object which becomes with paper, plastics, etc. penetrates an inspection object and performs foreign matter detection etc. from the transmitted light. although the advantage which shows 3 successive installation beam thing for the lighting section, and aims at increase of the quantity of light compared with the thing of one train or two trains is in both sides in drawing 1 on both sides of the perpendicular T which becomes perpendicular to the control surface (front face) of an inspection object, respectively — one train — 2 successive-installation **** operation can also be carried out, four or more trains are established, and you may make it increase the quantity of light further Although the effectiveness that brightness becomes equal in every part of this longitudinal direction by arranging all emitters can be further heightened so that it may differ by the longitudinal direction of the emitter group by which the exposure location of each emitter of all the lighting sections has been arranged in said lighting section at the line at two or more successive installation **** case All emitters may be arranged so that it may differ from the exposure location of each emitter of other lighting sections with which only the exposure location of each emitter of a part of lighting sections remains. As a means to change said exposure location, the pitch of each illuminants of all the lighting sections is set up identically. So that the exposure locations of each emitter of the part of all the lighting sections or all the

lighting sections may differ by emitter orientation (longitudinal direction of said emitter group) shift and arrange a part or all the lighting sections, or You may make it the exposure locations of each illuminant of a part or all the lighting sections differ by other exposure locations and illuminant orientation of each illuminant of the lighting section by changing the pitch of each illuminants of the specific lighting section with the pitch of each illuminants of other lighting sections.

[0006] It arranges so that two or more each of said lighting section may be distributed to both sides on both sides of the perpendicular which becomes perpendicular to the front face of an inspection object and may be irradiated from [of this inspection object / to the same part / mostly different] across.

[0007] The lighting section which was able to be distributed to the one side of two or more lighting sections distributed to said both sides can increase the quantity of light by constituting said linear light source from an arranged thing of an inspection object so that it may irradiate to the same part mostly.

[0008] So that each illuminant which constitutes said other specific remaining linear light sources may be located among each illuminants which constitute the pitch of each illuminant which constitutes said linear light source in the same pitch in every linear light source, and constitute said specific linear light source By the ability shifting the location of the specific linear light source of this everything but the remainder in the direction of [when seeing the specific linear light source of this everything but the remainder from this specific linear light source] to this specific linear light source The exposure location to the inspection object from each emitter of the lighting section located in one side as mentioned above and the exposure location to the inspection object from each emitter of the lighting section located in the other side are changed in the orientation of an emitter. It will irradiate, after a part of light from each emitter of the lighting section has overlapped as mentioned above.

[0009] It not only becomes advantageous, but compared with the case where various lamps constitute, in power consumption and an exoergic side, a life is long by leaps and bounds, and there is an advantage with a slow degradation speed by constituting said illuminant from a light emitting diode or a chip mold light emitting diode. In addition, there is an advantage which the case where the light emitting diode of a shell mold is used can make condense effectively with a condensing means compared with the case of a chip mold light emitting diode.

[0010] Since light is perpendicularly irradiated to the inspection object caudad located through the clearance formed among the lighting sections distributed to said both sides, the 2nd lighting section which the emitter of a large number which intervene and irradiate a condensing means at the half mirror arranged in the upper part part of this clearance becomes from the 2nd linear light source arranged at the line almost parallel to the orientation of said emitter is arranged. By constituting as mentioned above, it is condensed by condensing means, such as a cylindrical lens, and the light from the 2nd lighting section is changed into a band-like light, is irradiated from a perpendicular direction to an inspection object, and even when a flat [a control surface], it can conduct good inspection.

[0011] Two or more each of the lighting section from which many emitters arrange and come to constitute a condensing means in the optical exposure side of the linear light source arranged at the line It arranges so that it may distribute to both sides on both sides of the perpendicular which becomes perpendicular to the front face of an inspection object and may irradiate from [of an inspection object / to the same part / mostly different] across. Since light is perpendicularly irradiated to the inspection object caudad located through the clearance between the lighting sections distributed to said both sides The 2nd lighting section which the emitter of a large number which intervene and irradiate a condensing means at the half mirror arranged in the upper part part of this clearance becomes from the 2nd linear light source arranged at the line almost parallel to the orientation of said emitter is arranged. Each emitter of this 1st lighting section and each emitter of this 2nd lighting section are arranged so that each location where each emitter of said specific 1st lighting section irradiates an inspection object at least may differ from each location where each emitter of said 2nd lighting section irradiates an inspection object. A checking lighting system can also be constituted. Therefore, by changing the

exposure location to the inspection object from each emitter of a part (specification) or all the lighting sections, and the exposure location to the inspection object from each emitter of the 2nd lighting section, after a part of light from each emitter of the lighting section and light from each emitter of the 2nd lighting section have overlapped, it will irradiate. Moreover, by changing the exposure location to the inspection object from each emitter of a part of (specification) lighting sections, and the exposure location to the inspection object from each emitter of the remaining lighting section, after a part of light from each emitter of the lighting section has overlapped, it will irradiate. Moreover, after a part of light from each emitter of the 2nd lighting section has overlapped two or more successive installation **** case by changing an exposure location [as opposed to the inspection object from each emitter of a part of 2nd lighting sections for the 2nd lighting section], and the exposure location to the inspection object from each emitter of the remaining 2nd lighting section, it will irradiate.

[0012] The diffusion plate for diffusing the light from said emitter between said condensing means and inspection objects is arranged. Although a strong light (light near the optical axis of an emitter) reflected regularly from the emitter of the specific lighting section among the light from the emitter of two or more lighting sections with which include angles differ on the relation made to condense with a condensing means can be incorporated for the image pick-up means In spite of being unable to incorporate a strong light reflected regularly from the emitter of other another lighting sections for said image pick-up means but illuminating in two or more lighting sections, the light incorporated to an image pick-up means will become dark. Then, since the light from the emitter of other another lighting sections which was not able to be incorporated by forming a diffusion plate as mentioned above can also be incorporated for an image pick-up means, light incorporated to an image pick-up means can be made bright.

[0013] Two or more each of said lighting section is arranged on both sides on both sides of the perpendicular which becomes perpendicular to the front face of an inspection object in the condition that a clearance occurs, among these lighting sections, and the reflected light which it irradiated from said lighting section and reflected the front face of an inspection object is constituted possible [recognition] through the clearance between said lighting sections.

[0014] Many emitters may arrange a condensing means to the optical exposure side of the linear light source arranged at the line, the diffusion means for making the orientation of an emitter diffuse the light from said linear light source may be established the front or behind the condensing means, and a checking lighting system may be constituted. By establishing a diffusion means the front or behind a condensing means as mentioned above Before the light from each emitter is condensed, or after being condensed, it is spread in the orientation of an emitter. For example, when copying the direct light source as a back light, or making the glossy surface of the inspection object which has a glossy surface carry out specular reflection and seeing, the ball of emitters, such as light emitting diode, can cancel the phenomenon in which light will break [between direct vanity, an emitter, and emitters] off. Although the light h in the condition of the ball of light emitting diode 25 having not appeared directly, and having been formed in band-like can specifically be seen if the light h which irradiated paper 1 and has been reflected from light emitting diode 25 is seen with a naked eye I when the inspection object 1 is paper as shown in drawing 20 (a) As shown in drawing 20 (c), when the inspection object 1 is a mirror plane When it sees with a naked eye I, the ball of light emitting diode 25 can cancel this by using a diffusion means as mentioned above by between direct vanity, light emitting diode 25, and light emitting diodes 25 generating the phenomenon in which light will break off. And as shown in drawing 20 R> 0 (b), when copying the direct light source as a back light, the ball of the light emitting diode 25 shown by drawing 20 (c) will be visible to band-like [even a grain appears / with which not a condition but these balls were connected into small pieces] by using the diffusion means 28 which consists of a diffusion plate etc. In this case, the lighting section may be single, and in order to raise brightness, more than one can be prepared and it can also carry out. As said diffusion means, a majority of heights of various kinds of configurations along the one direction which intersects perpendicularly with the orientation of an emitter can be formed in a front face along with the orientation of this emitter, or it is what equipped the interior of the transparent body with diffusion members, such as an optical fiber, and can constitute. In addition, drawing 20

(a), (b), and (c) omit a condensing means.
[0015]
[Embodiment of the Invention] The checking lighting system which can be illuminated in order to inspect surface irregularity, a surface soldered part which is not illustrated of a printed circuit board 1 as an inspection object to drawing 1 is shown. This checking lighting system arranges two (you may be three or more) of the 1st lighting sections 3 which are the lighting section which distributes to both sides on both sides of the perpendicular T which becomes perpendicular to the flat control surface (front face) of a printed circuit board 1, and irradiates in the casing 2 of a cube type by the shape of a rectangle by which the lower part was opened wide from [of a printed circuit board 1 / to the same part / mostly different] across. Although the lighting system for surface analyses which inspects by here incorporating the reflected light which reflected the front face of an inspection object is shown, you may be the checking lighting system used when incorporating the transmitted light which penetrated the inspection object which becomes with transparence or a translucent ingredient and performing foreign matter detection etc. An image processing is carried out with the image processing system which is not illustrating the image which caught the reflected light reflected in said inspection object with the line sensor camera (not shown) arranged above long hole 5A (refer to drawing 8) of the superior lamella section 5, it projects on a monitor etc. and human being may be made judge the quality of the image by computer, or to judge a quality. In addition, you may be the configuration of omitting said line sensor camera depending on the case, and inspecting an inspection object by viewing.
[0016] As shown in drawing 1 , the clearance S between the dimensions of the almost same magnitude as the width of face (magnitude of the direction which become perpendicular to a longitudinal direction) of said long hole 5A be opened, and said 1st lighting sections 3 and 3 be arranged, and they be arranged so that Ha's character type may be made in the inclination posture, i.e., side view, in which the side which separate from Clearance S be located more nearly caudad. Since each of said 1st lighting sections 3 and 3 is the same configuration, it explains only one 1st lighting section 3. Said 1st lighting section 3 is substrate 15L (in other substrate 15R) about the 1st linear light source 14, 14, and 14 of three trains arranged at the line in the direction in which space and each of three light emitting diodes VL1, VL2, and VL3 which set predetermined spacing in the direction of slant, and were arranged in it cross at right angles in drawing 1 . [many] VR1, VR2, and VR3 are attached — ****, while attaching The cylindrical lenses (as long as it can make it condense, what kind of thing may be used) 16, 16, and 16 as three condensing means are arranged through transparent support plate 16A almost in parallel with these light emitting diodes VL1, VL2, and VL3 to the light side of each [these] 1st linear light source 14. It is constituted. In addition, what really formed said three cylindrical lenses 16, 16, and 16 and said support plate 16A may be used.
[0017] As shown in drawing 2 , to optical-axis 13A of each light emitting diode VL2 of the 1st linear light source 14 arranged in the center of the 1st linear light source 14, 14, and 14 of three trains It changes into the condition of having made the core of said cylindrical lens 16 arranged corresponding to this agreeing. As opposed to the distance (the 1st linear light source 14, distance between 14 (pitch)) P1 to the 1st linear light source VL1 and VL3 of two trains located in both sides to the 1st linear light source 14 located in said center By making small distance (distance between a cylindrical lens 16 and 16 (pitch)) P2 to the cylindrical lenses 16 and 16 located in both sides to the cylindrical lens 16 located in said center Although it enables it to make one place condense the opticals axis 13A, 13A, and 13A from three cylindrical lenses 16, 16, and 16 Each location of the cylindrical lenses 16, 16, and 16 to light emitting diodes VL1, VL2, and VL3 is made the same. By changing the include angle of the light emitting diodes VL1 and VL3 and the cylindrical lenses 16 and 16 which are located in both sides to light emitting diode VL2 and the cylindrical lens 16 which are located in the center You may enable it to make one place condense the opticals axis 13A, 13A, and 13A from three cylindrical lenses 16, 16, and 16. In this case, it is separate and substrate 15L to light emitting diodes VL1, VL2, and VL3 may be constituted.
[0018] The arrangement condition of the light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 attached in the same installation location in said same pitch is shown in drawing 3 , and the

condition of the light by these light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 is shown in drawing 5 . It is got blocked. Among the light H1 and H1 to the inspection object from the light emitting diodes VL1, VL2, and VL3 which adjoin each other by the longitudinal direction of the 1st linear light source 14 of three trains attached in substrate 15L (it arranges to the down side in drawing 3) located in left-hand side So that the light H2 to the inspection object from each light emitting diodes VR1, VR2, and VR3 arranged along with the longitudinal direction of the 1st linear light source 14 of three trains attached in substrate 15R (it arranges to the up side in drawing 3) located in right-hand side may be overlapped and located You make it located in the location to which the location of right-hand side substrate 15R was moved in the direction of [when seeing substrate 15R of another side from one substrate 15L] by the half-pitch of the pitch (spacing) of a light emitting diode 13 and 13 comrades to left-hand side substrate 15L. He is trying for the light irradiated by band-like to become the uniform quantity of light which does not have a dark part in every part. Although the location of the substrates 15L and 15R of said right and left was shifted in drawing 3 By what the attaching position of the light emitting diodes VL1, VL2, and VL3 arranged in one substrate 15L and the attaching position of the light emitting diodes VR1, VR2, and VR3 arranged in substrate 15R of another side are changed for (it shifts) You may constitute so that the light irradiated by band-like as mentioned above may become the uniform quantity of light which does not have a dark part in every part. By a diagram, although the 1st linear light source 14 of three trains is shown, the 1st linear light source of one train, two trains, or four trains or more can also be established and carried out. Moreover, the 1st linear light source 14 of two or more trains is attached in the same substrate 15L or 15R, and also it can also attach and carry out to the substrate only for single tiers every.

[0019] It can arrange and said light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 can also be carried out, as shown in drawing 4 . Each of light emitting diodes VL1, VL2, and VL3 is attached in substrate 15L (in drawing 4 , it arranges to the down side) located in said left-hand side so that it may differ in the direction which is the same pitch PA and intersects perpendicularly with the orientation (longitudinal direction of a light emitting diode group) of each light emitting diode. Moreover, light emitting diodes VR1, VR2, and VR3 are attached in substrate 15R (in drawing 4 , it arranges to the up side) located in said right-hand side so that it may differ in the direction which is the same pitch PA and intersects perpendicularly with the orientation of each light emitting diode. In addition, although light emitting diodes VL2 and VR3 are the same locations in the direction which intersects perpendicularly with the longitudinal direction of the orientation light emitting diode group of light emitting diode, it can also carry out by making it differ. By arranging light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 as mentioned above When the right-hand side light emitting diodes VR1, VR2, and VR3 are seen from the left-hand side light emitting diodes VL1, VL2, and VL3 Although a part of both installation location overlaps, it will be in the condition that most differ. A part of light when irradiating these light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 can make it overlap, for example, enables it to make it overlap between VL2, VL3, or VL3 and VR1. In addition, although drawing 4 R> 4, drawing 11 mentioned later, and drawing 12 showed the condition of having vacated greatly between light emitting diodes in order to make arrangement of light emitting diode intelligible, with the naked eye, it will be arranged like drawing 3 in fact at the dense condition.

[0020] By forming and carrying out the diffusion plate K with which the through tube K1 for passing the reflected light from a printed circuit board 1 was formed in the core in the opening of said casing 2, as shown in drawing 6 The exposure nonuniformity of the light from light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 can be eased, and a printed circuit board 1 irradiates, and you may constitute so that this reflected light can be incorporated as much as possible for an upper image pick-up means along with Perpendicular T. When it assumes that brightness falls in one half mostly by forming said diffusion plate K, in the light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 of six trains From the ability of this light reflected as mentioned above to be incorporated as much as possible for an upper image pick-up means along with Perpendicular T, although only the brightness of the light of the light emitting diode of three trains is obtained The direction at the time of forming the diffusion plate K in fact becomes advantageous in exposure nonuniformity and the brightness of light incorporated compared with the case where the

diffusion plate K is not formed. Moreover, in exposure nonuniformity and the brightness of light incorporated, it can be made still more advantageous by making said diffusion plate K thin and bringing close to a printed circuit board 1 as much as possible. And although a part of both installation location overlaps when the right-hand side light emitting diodes VR1, VR2, and VR3 are seen as mentioned above from the left-hand side light emitting diodes VL1, VL2, and VL3, in said exposure nonuniformity, it becomes still more advantageous by considering as the condition that most differ. Although the diffusion plate K has been horizontally arranged to the light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 arranged aslant [said], you may arrange aslant so that the diffusion plate K may become parallel to light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3.

[0021] If the difference when having not formed the case where said diffusion plate K is formed, and the diffusion plate K is explained briefly As shown in drawing 7 (a), the image pick-up means 23 is formed in the location which leaned only the include angle theta to the left-hand side of drawing to the perpendicular T which becomes perpendicular to the inspection object which is not illustrated. Two trains of the linear light source by which much light emitting diodes 22 and 22 were attached in the right-hand side of drawing in the perpendicular direction to space like the above (although two trains are shown here in order to simplify explanation) one train or three trains or more — you may be — what has arranged and has arranged the cylindrical lens 16 to the exposure side side of these linear light sources is shown. In drawing, the right-hand side linear light source arranges in the location which leaned only the include angle theta to right-hand side to said perpendicular T. Therefore, although only the direct reflected light (specular reflection light) from the right-hand side light emitting diode 22 is incorporated by the image pick-up means 23 among the light irradiated by the flat control surface of an inspection object from each light emitting diode 22 and 22, the direct reflected light (specular reflection light) from the left-hand side light emitting diode 22 cannot be incorporated. Therefore, by being able to incorporate only the light from one linear light source for the image pick-up means 23, but arranging the diffusion plate K, as shown in drawing 7 (b) to becoming dark, the light from all linear light sources can be made to reflect in the image pick-up means 23 not a little, and it can avoid becoming dark like drawing 7 (a). In addition, if the number of a linear light source increases, the effectiveness by forming the diffusion plate K indeed will become remarkable. Drawing 5 , drawing 13 , and drawing 14 do not show the direct reflected light (specular reflection light) of a linear light source, and show the scattered light scattered about on the front face of a printed circuit board 1.

[0022] Although there is an advantage which can attain a miniaturization by constituting a checking lighting system only from the 1st lighting sections 3 and 3 in drawing 1 , the 2nd lighting section 4 may be formed in drawing 8 - drawing 10 . This checking lighting system contains two (you may be three or more) of the 1st lighting sections 3 and the 2nd lighting section 4 which are the lighting section which distributes to both sides on both sides of the perpendicular T which becomes perpendicular to the control surface of a printed circuit board 1, and irradiates in the casing 2 of a cube type from [of a printed circuit board 1 / to the same part / mostly different] across, and consists of shape of a rectangle by which the lower part was opened wide. said casing 2 — method ** of order — although wrap right-and-left Itabe 6 and 7 and order are consisted of wrap order Itabe 8 and 9 in the superior lamella section 5 by which checking long long hole 5A was mostly formed in the center at the longitudinal direction, and right and left, you may be things other than the configuration shown in drawing. 10, 11, and 12 which are shown in drawing 8 and drawing 9 are a cable for supplying power to said 1st lighting sections 3 and 3 and the 2nd lighting section 4. Here, although the thing equipped with the 1st lighting sections 3 and 3 and the 2nd lighting section 4 of a pair is shown, the 2nd lighting section 4 is omitted, and it is what formed only the 1st lighting sections 3 and 3 of a pair, and you may constitute. An image processing is carried out with the image processing system which is not illustrating the image which caught the reflected light reflected in said inspection object like the above-mentioned with the line sensor camera (not shown) arranged above long hole 5A of the superior lamella section 5, it projects on a monitor etc. and human being may be made judge the quality of the image by computer, or to judge a quality. In addition, you may be the configuration of omitting said line

sensor camera depending on the case, and inspecting an inspection object by viewing.
[0023] As shown in drawing 11 , each of light emitting diodes VL1, VL2, and VL3 is attached in substrate 15L (in drawing 11 , it arranges to the down side) located in said left-hand side so that it may differ in the direction which is the same pitch PA and intersects perpendicularly with the orientation of each light emitting diode. Moreover, light emitting diodes VR1, VR2, and VR3 are attached in substrate 15R (in drawing 11 , it arranges to the up side) located in said right-hand side so that it may differ in the direction which is the same pitch PA and intersects perpendicularly with the orientation of each light emitting diode. In addition, although light emitting diodes VL2 and VR3 are the same locations in the direction which intersects perpendicularly with the orientation of light emitting diode, it can also carry out by making it differ. By arranging light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 as mentioned above When the right-hand side light emitting diodes VR1, VR2, and VR3 are seen from the left-hand side light emitting diodes VL1, VL2, and VL3 Although a part of both installation location overlaps, it will be in the condition that most differ. A part of light when irradiating these light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 can make it overlap, for example, enables it to make it overlap between VL2, VL3, or VL3 and VR1. Although 19 shown in drawing 11 shows the light emitting diode of said 2nd lighting section 4 (it displays with the square in order to distinguish from the light emitting diode of the 1st lighting section easily) and makes it the same pitch as said light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3, it may be a different pitch. Moreover, by drawing 12 , although the light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 of said 1st lighting section 3 are the same as that of drawing 11 , the case where only the installation location of the light emitting diode 19 of said 2nd lighting section 4 is changed is shown (in order to distinguish from the light emitting diode of the 1st lighting section easily, it displays with the square).
[0024] The installation location of light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 is identically set up towards intersecting perpendicularly with the orientation of light emitting diode so that the exposure location of said all light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 may become the same part. You may arrange and carry out so that the exposure location of said light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3 may differ from the exposure location of the light emitting diode 19 of said 2nd lighting section 4 in the orientation of light emitting diode. In this case, as shown in drawing 13 , it will irradiate, after the light H5 of light emitting diode 19 has overlapped between H1 (H2), the light H1 (H2) of light emitting diodes VL1, VL2, VL3, VR1, VR2, and VR3, and, and can control that the part which becomes dark occurs.
[0025] Said 2nd lighting section 4 is constituted so that light may be perpendicularly irradiated to the inspection object 1 caudad located through the 1st lighting section 3 of said pair, and the clearance S between three comrades. Specifically As shown in drawing 8 - drawing 10 , the upper part part of Clearance S, It is a cylindrical lens (it is the thing which can make it condense) as a condensing means to the half mirror 17 which will have been arranged in the lower part part of long hole 5A if put in another way, and this half mirror 17. If it is, much light emitting diodes 19 with which anythings intervene and irradiate good 18 consist of the 2nd linear light source 21 arranged through a substrate 20 at the line almost parallel to the orientation of said light emitting diode 13. By a diagram, although only the single tier is forming and carrying out light emitting diode 19, two or more successive installation **** operation can also be carried out.
[0026] Although it is effective when the case where the thing of a shell mold is used makes it condense as said light emitting diode 13, you may be the light emitting diode of the chip mold which can raise packaging density.
[0027] Said checking lighting system can also be constituted as shown in drawing 14 (a) and (b). That is, the substrate 26 with which predetermined spacing was kept on the straight line, and much light emitting diodes [a majority of] 25 were supported inside [one side was opened wide] the casing 24 of a core box, The diffusion plate 28 as a diffusion means for making the orientation X of light emitting diode 25 diffuse the light from said light emitting diode 25 (you may constitute from a transparent acrylic board etc. and the thing on a sheet may be used), In order to make the light diffused with this diffusion plate 28 condense, the cylindrical lens 27 as a

condensing means located in the open end of casing 24 is arranged. Although the diffusion plate 28 is here arranged where a field is approached or contacted after a back [of a cylindrical lens 27] 25, i.e., light emitting diode, side (back) As shown in drawing 15 , they are locations (although drawing shows three locations in all including the rear face) other than the after (back) side of the back locations by the side of light emitting diode 25. except the location shown in drawing — ****** — the diffusion plate 28 may be arranged, and the diffusion plate 28 can be arranged ahead of a cylindrical lens 27, it can also carry out, and you may arrange to both the front of a cylindrical lens 27, and back depending on the case. As for the permeability of said diffusion plate 28, it is desirable that setting up to 80% or more causes the fall of the brightness by transparency of light few.

[0028] As shown in drawing 16 , said diffusion plate 28 is that by which the cross-section configuration formed a majority of semicircle-like heights 28a in the front face (top face) as for which the light from said light emitting diode 25 carries out incidence mostly along with the orientation X of said light emitting diode 25, and is constituted. And said each heights 28a is constituted by the configuration long in the direction (direction which intersects perpendicularly with space) which intersects perpendicularly with the orientation X of said light emitting diode 25. Thus, the light (light which carries out incidence from a lower part in a drawing) which has carried out incidence to the constituted diffusion plate 28 from said light emitting diode 25 diffuses in said orientation X from a front face. As a configuration of said irregularity, as shown in drawing 17 , a cross-section configuration may be a configuration to which wave-like, shape of i.e., semicircle, heights 28A and semicircle-like crevice 28B are located in said orientation X by turns.

[0029] As said diffusion means, as mentioned above on the front face (optical incidence side face) of the diffusion plate 28 Although a majority of heights of various kinds of configurations along the one direction which intersects perpendicularly with the orientation X of light emitting diode 25 were formed along with the orientation X of this light emitting diode 25, as it is shown in others and drawing 18 (a) The diffusion plate 28 may consist of things which regular intervals were put [things] on the interior of the transparent body, and made it equipped with the diffusion members [being cylindrical (what kind of configuration being sufficient as a configuration)] 29, such as an optical fiber, along with the orientation X of said light emitting diode 25. Moreover, make the interior of the transparent body equipped with one more kind (for you to be two or more kinds) from which the diameter other than the diffusion member 29 shown by drawing 18 (a) differs in drawing 18 (b). What it was made to be equipped with two kinds of diffusion members 29 and 30 by turns along with the orientation X of said light emitting diode 25, and constituted the diffusion plate 28 is shown. That is, in drawing 18 (c) The diffusion member 31 which is in the condition to which the part projected the diffusion members [being cylindrical (what kind of configuration being sufficient as a configuration)] 31, such as an optical fiber, on the front face (top face), and adjoins each other, and the thing which was made to have in the dense condition that there is no clearance, among 31, and constituted the diffusion plate 28 are shown.

[0030] Thus, by using the diffusion plate 28 of drawing 16 - drawing 18 , as the light h irradiated by the inspection object 1 through the diffusion plate 28 and a cylindrical lens 27 from said light emitting diode 25 shows drawing 19 , it will be spread. And when copying the direct light source as a back light, or making the glossy surface of the inspection object 1 which has a glossy surface carry out specular reflection and seeing as shown in drawing 20 (c) as shown in drawing 20 (b), the ball of light emitting diode 25 can cancel the phenomenon in which light will break [between direct vanity, light emitting diode 25, and light emitting diodes 25] off. In addition, it is shown in drawing 20 (c) as an example of a comparison irradiated without using said diffusion plate 28. Moreover, said diffusion plate

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[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the vertical section side elevation of a checking lighting system.
[Drawing 2] It is the explanatory view of an important section showing the structure of the installation section of light emitting diode and a cylindrical lens.
[Drawing 3] It is the explanatory view showing arrangement of the light emitting diode of the lighting system of drawing 1 .
[Drawing 4] It is the explanatory view showing other arrangement of light emitting diode.
[Drawing 5] It is the explanatory view showing the image sample of the light by the light emitting diode of the 1st lighting section shown by drawing 1 .
[Drawing 6] It is the vertical section side elevation furnished with a diffusion plate of another checking lighting system.
[Drawing 7] Another arrangement of an image pick-up means and light emitting diode is shown, the case where (a) does not have a diffusion plate is shown and (b) shows the case where there is a diffusion plate.
[Drawing 8] It is the vertical section side elevation of another checking lighting system.
[Drawing 9] It is the top view of another checking lighting system.
[Drawing 10] It is the vertical section side elevation of another checking lighting system.
[Drawing 11] It is the explanatory view showing arrangement of the light emitting diode of the lighting system of drawing 8 .
[Drawing 12] It is the explanatory view showing another arrangement of the light emitting diode of the lighting system of drawing 8 .
[Drawing 13] It is the explanatory view showing the image sample in the condition that the light of the 1st lighting section and the light of the 2nd lighting section overlap.
[Drawing 14] Another checking lighting system is shown and they are the sectional view which cut (a) by the orientation of light emitting diode, and the sectional view cut towards the orientation of light emitting diode and (b) crossing at right angles.
[Drawing 15] It is the sectional view which made the lighting system of drawing 14 equipped with three diffusion plates.
[Drawing 16] It is the sectional view of another diffusion plate.
[Drawing 17] It is the sectional view of another diffusion plate.
[Drawing 18] (a), (b), and (c) are the sectional views of another diffusion plate.
[Drawing 19] It is the explanatory view showing the image sample of the light when irradiating using the checking lighting system shown by drawing 14 .
[Drawing 20] (a), (b), and (c) are the explanatory views showing the condition of the light when seeing the light from light emitting diode.
[Drawing 21] It is the explanatory view showing the image sample of the light by the conventional lighting section.
[Description of Notations]
1 Printed Circuit Board (Inspection Object)
2 Casing 3 1st Lighting Section
4 2nd Lighting Section 5 Superior Lamella Section

5A Long hole 6 Seven Right-and-left Itabe
8 Nine Order Itabe 10, 11, 12 Cable
13A Optical axis 14 The 1st linear light source
15L, 15R Substrate 16 Cylindrical lens
16A Support plate 17 Half mirror
18 Cylindrical Lens
19 Light Emitting Diode 20 Substrate
21 2nd Linear Light Source 22 Light Emitting Diode
23 Image Pick-up Means 24 Casing
25 Light Emitting Diode 26 Substrate
27 Cylindrical Lens (Condensing Means)
28 Diffusion Plate (Diffusion Means)
28A Heights 28B Crevice
28a Heights
29-31 Diffusion member 32 33 Field
H1, H2, H3, H4 Light
P1, P2, PA Pitch
K Diffusion plate K1 Through tube
S Clearance T Perpendicular
VL1, VL2, VL3 Light emitting diode
VR1, VR2, VR3 Light emitting diode
X Orientation of light emitting diode

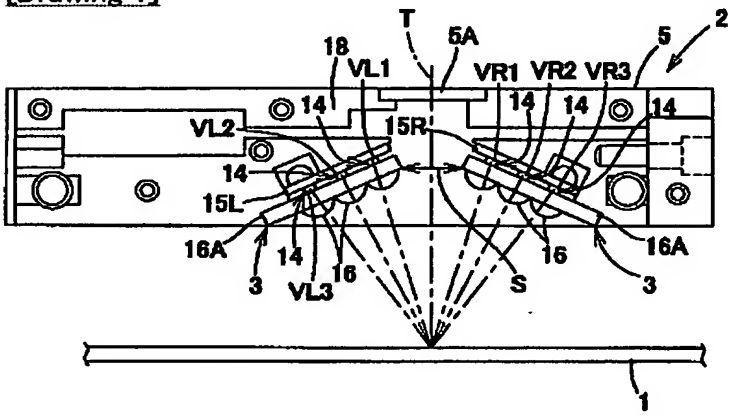
[Translation done.]

* NOTICES *

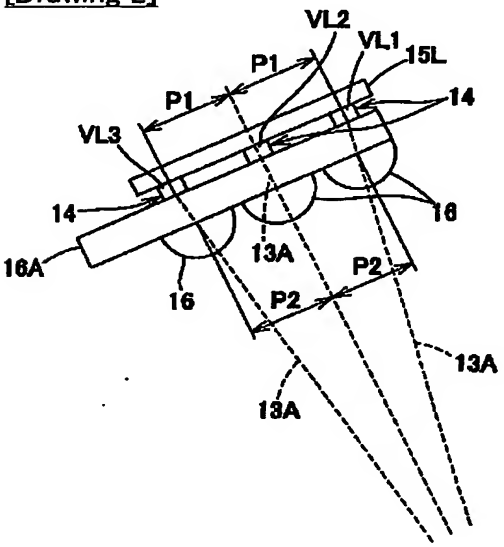
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



[Drawing 2]



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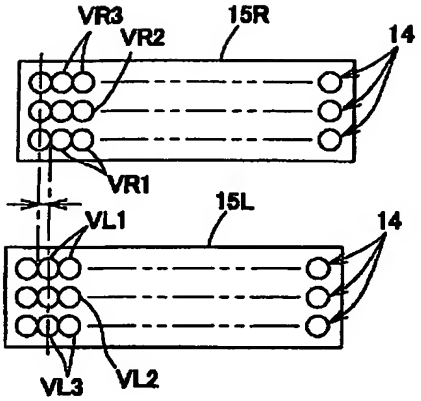
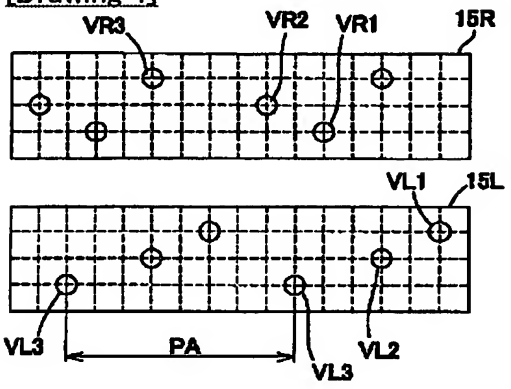


[Drawing 4]



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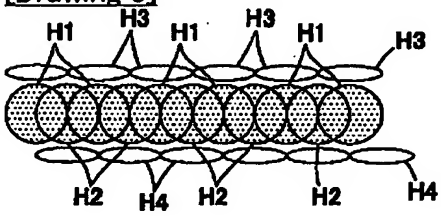
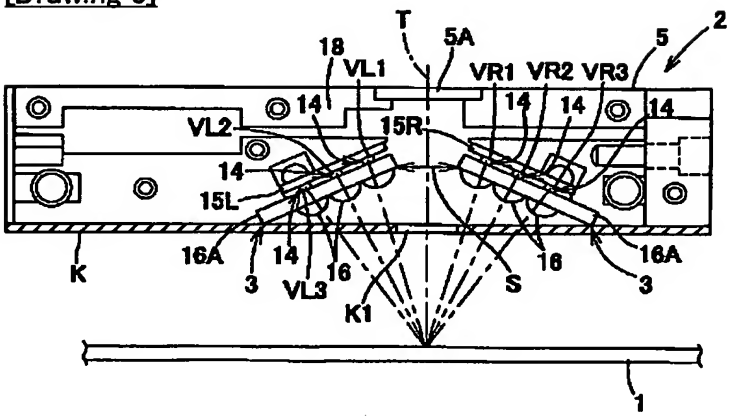
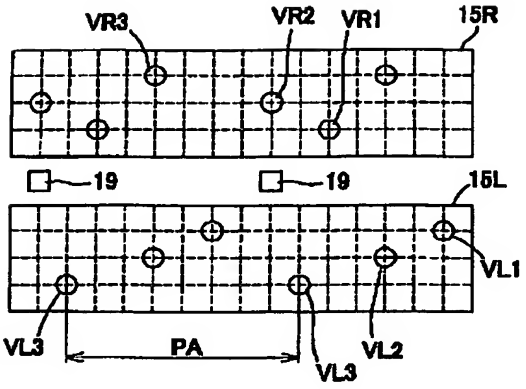


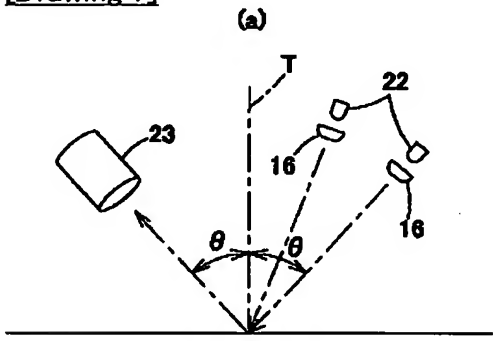
[Drawing 6]

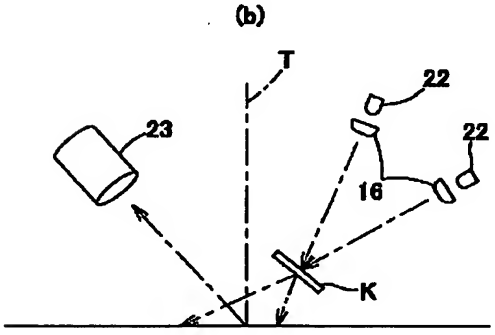


[Drawing 11]



[Drawing 7]





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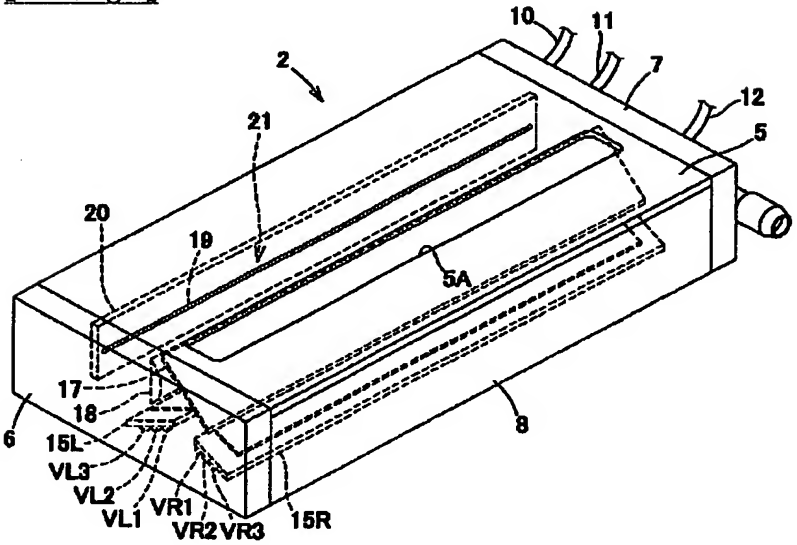

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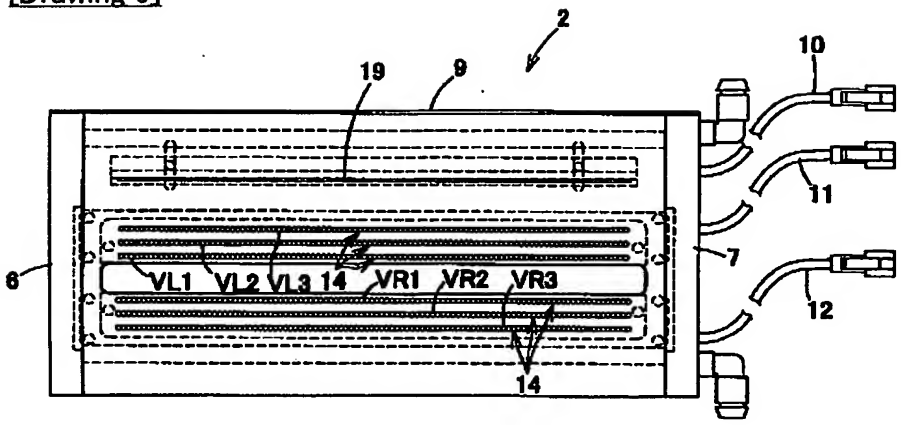
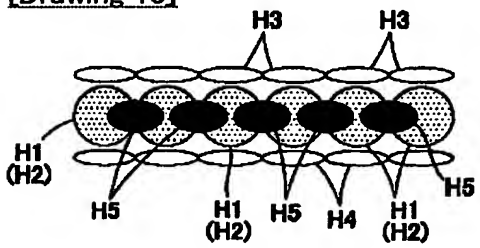
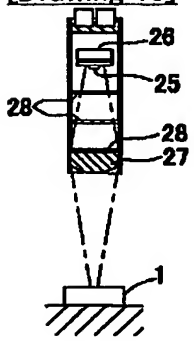


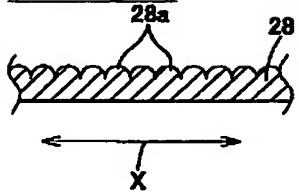
[Drawing 13]



[Drawing 15]



[Drawing 16]



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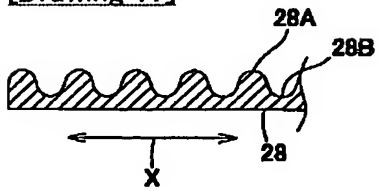

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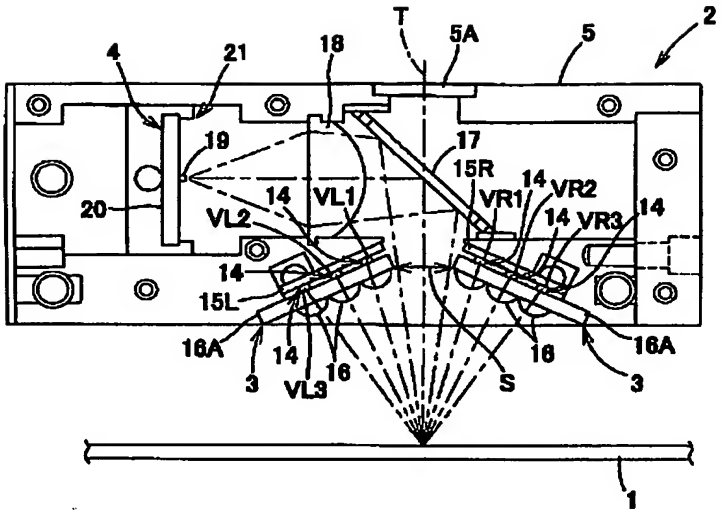

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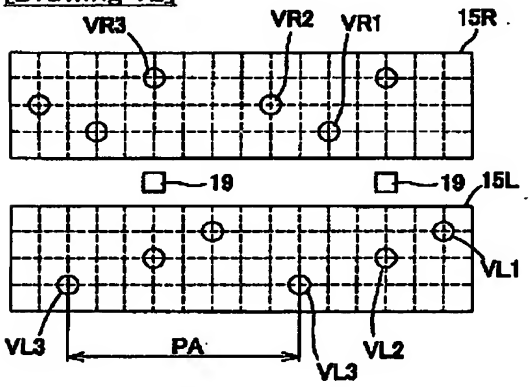
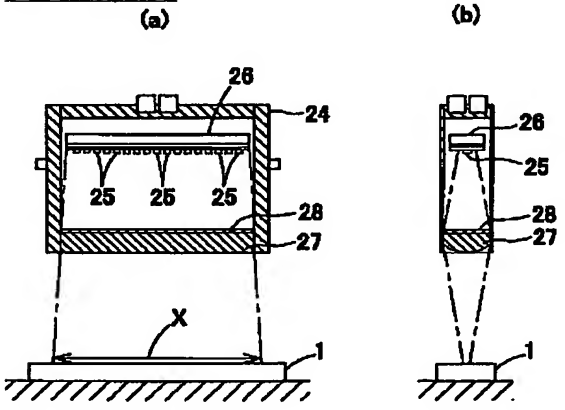


[Drawing 14]



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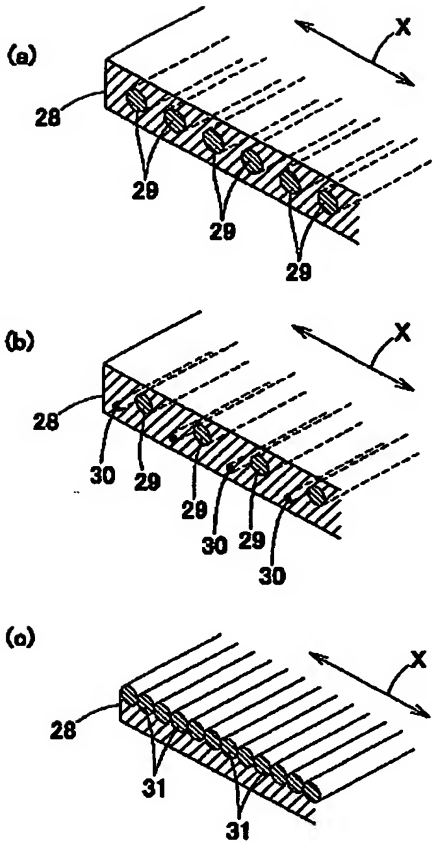
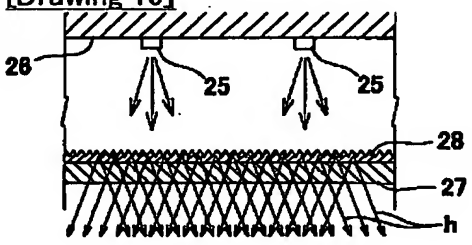


[Drawing 19]



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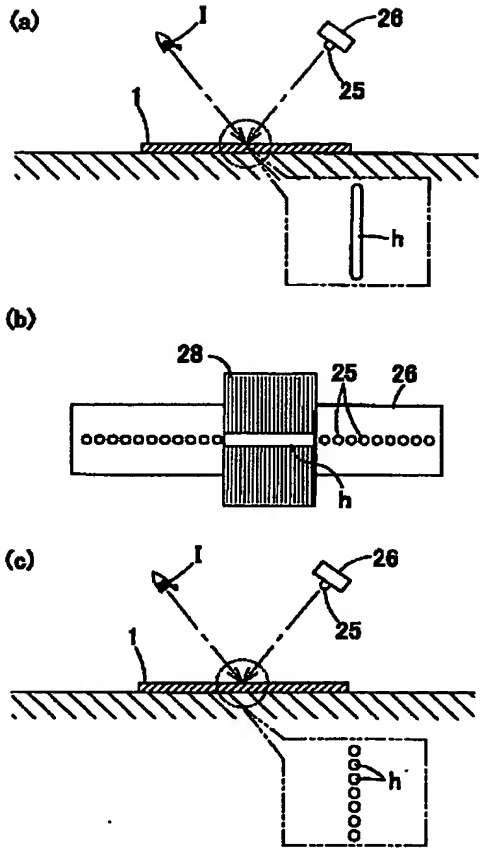
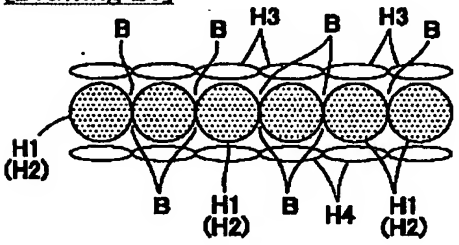


[Drawing 21]



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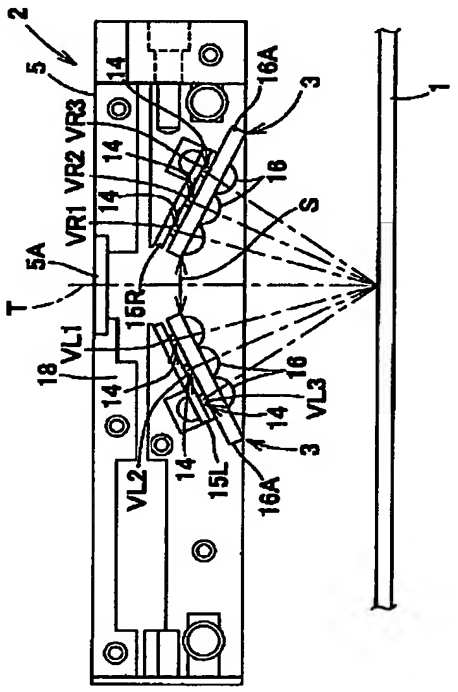
(71)出願人　596099446
シーシーエス株式会社
京都府京都市上京区烏丸通下立売上ル桜鶴円町374番地
(72)発明者　増村　茂樹
京都市上京区烏丸通下立売上ル桜鶴円町374番地　シーシーエス株式会社内
(72)発明者　米田　賢治
京都市上京区烏丸通下立売上ル桜鶴円町374番地　シーシーエス株式会社内
(74)代理人　100074561
弁理士　柳野　隆生

最終頁に続く

(54)【発明の名称】　検査用照明装置

(57)【要約】
【課題】　暗くなる箇所が発生することなく、どの箇所においても均等に照らすことができる表面検査用照明装置を提供する点にある。
【解決手段】　多数の発光体が線状に配置された線状光源１４の光照射側に集光手段１６を配置してなる照明部３の複数のそれぞれを、検査対象物のほぼ同一箇所に対して照射し、該照明部３の各発光体ＶＬ１が検査対象物を照射するそれぞれの位置と該別の照明部３の各発光体ＶＲ１が検査対象物を照射するそれぞれの位置とが照射する線状の発光体群の長手方向において異なるように複数の照明部３の各発光体ＶＬ１、ＶＲ１を配置したことを特徴とする。



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【特許請求の範囲】

【請求項１】　多数の発光体が線状に配置された線状光源の光照射側に集光手段を配置してなる照明部の複数のそれぞれを、検査対象物のほぼ同一箇所に対して照射し、該照明部の各発光体が検査対象物を照射するそれぞれの位置と該別の照明部の各発光体が検査対象物を照射するそれぞれの位置とが照射する線状の発光体群の長手方向において異なるように該複数の照明部の各発光体を配置したことを特徴とする検査用照明装置。

【請求項２】　前記照明部の複数のそれぞれを、検査対象物の表面に対して垂直となる垂線を挟んで両側に振り分けて該検査対象物のほぼ同一箇所に対して異なる斜め方向から照射するように配置してなる請求項１記載の検査用照明装置。

【請求項３】　前記両側に振り分けた複数の照明部のうちの一方側に振り分けられた照明部が、検査対象物のほぼ同一箇所に対して照射するように前記線状光源を複数配置したものでなる請求項２記載の検査用照明装置。

【請求項４】　前記線状光源を構成する各発光体のピッチをどの線状光源においても同一ピッチに構成し、前記特定の線状光源を構成する各発光体同士間に前記残りの他の特定の線状光源を構成する各発光体が位置するように、該特定の線状光源に対して該残りの他の特定の線状光源の位置を、該特定の線状光源から該残りの他の特定の線状光源を見たときの方向においてずらせてなる請求項１又は２記載の検査用照明装置。

【請求項５】　前記発光体が発光ダイオード又はチップ型発光ダイオードからなる請求項１～４のいずれかに記載の検査用照明装置。

【請求項６】　前記両側に振り分けた照明部同士間に形成される隙間を通して下方に位置する検査対象物に対して垂直方向から光を照射するために、該隙間の上方箇所に配置したハーフミラーに集光手段を介在して照射する多数の発光体が前記発光体の配置方向とほぼ平行の線状に配置された第２線状光源からなる第２照明部を配置してなる請求項１～４のいずれかに記載の検査用照明装置。

【請求項７】　多数の発光体が線状に配置された線状光源の光照射側に集光手段を配置して構成してなる照明部の複数のそれぞれを、検査対象物の表面に対して垂直となる垂線を挟んで両側に振り分けて検査対象物のほぼ同一箇所に対して異なる斜め方向から照射するように第１照明部を配置し、前記両側に振り分けた照明部同士の隙間を通して下方に位置する検査対象物に対して垂直方向から光を照射するために、該隙間の上方箇所に配置したハーフミラーに集光手段を介在して照射する多数の発光体が前記発光体の配置方向とほぼ平行の線状に配置された第２線状光源からなる第２照明部を配置し、前記第１照明部を構成する少なくとも１つの照明部の各発光体が検査対象物を照射するそれぞれの位置と前記第２照明部の各発光体が検査対象物を照射するそれぞれの位置とが異なるように該第１照明部の各発光体と該第２照明部の各発光体を配置したことを特徴とする検査用照明装置。

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【請求項８】　前記集光手段と検査対象物との間に、前記発光体からの光を拡散させるための拡散板を配置してなる請求項１又は７記載の検査用照明装置。

【請求項９】　前記照明部の複数のそれぞれを、該照明部同士間に隙間が発生する状態で検査対象物の表面に対して垂直となる垂線を挟んで両側に配置し、前記照明部から照射されて検査対象物の表面を反射した反射光を前記照明部同士間の隙間を通して認識可能に構成してなる請求項１～８のいずれか１項に記載の検査用照明装置。

【請求項１０】　多数の発光体が線状に配置された線状光源の光照射側に集光手段を配置し、その集光手段の前方又は後方に、前記線状光源からの光を発光体の配置方向に拡散させるための拡散手段を設けたことを特徴とする検査用照明装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、例えば工場等において検査対象物である製品に光を照射して反射してきた反射光により製品の外観や傷の検査の他、プリント基板上に実装した電子部品の半田付けの良否の検査を行う時等に用いられる検査用照明装置の他、透明又は半透明な材料、例えばプラスチックや紙等でなる検査対象物に照射し、その検査対象物を透過してきた透過光により異物検出等を行うために用いられる検査用照明装置に関する。

【０００２】

【従来の技術】上記検査用照明装置として、分かり易く説明するために、例えば本願発明の図１を用いて説明する。つまり、基板１５Ｌ、１５Ｒの長手方向（図において紙面に対して垂直方向）に沿って発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３の多数を配置してなる線状光源１４の３列それぞれを該基板１５Ｌ，１５Ｒに配置し、それら３つの線状光源１４，１４，１４それぞれの光照射側に帯状に集光させるためのシリンドリカルレンズ１６，１６，１６を支持板１６Ａを介して配置してなる左右一対の第１照明部３，３を、側面視においてハの字型をなすように配置することにより、検査対象物に対して斜め方向から光を照射して、例えばハンダ付けした箇所等のように検査面がフラットでない場合でも光を確実に当てて検査が行えるようにしている。そして、前記一方の第１照明部３を構成する発光ダイオードＶＬ１，ＶＬ２，ＶＬ３の長手方向における取り付け位置と、該一方の第１照明部３から他方の第１照明部３を見たときに他方の第１照明部３を構成する発光ダイオードＶＲ１，ＶＲ２，ＶＲ３の長手方向における取り付け位置とが同一であるため、以下に述べる不都合が発生していた。

【０００３】
【発明が解決しようとする課題】つまり、上記構成によれば、図１４に示すように、一方の各発光ダイオードＶＬ１，ＶＬ２，ＶＬ３からの光Ｈ１とこれに対応する他方の各発光ダイオードＶＲ１，ＶＲ２，ＶＲ３からの光Ｈ２とが同一箇所を照射するため、図に示すように、長手方向で隣り合う発光ダイオードの光同士間に照らされていない暗くなる箇所Ｂ（図では光間の上下２箇所）が発生してしまい、その部分での検査が良好に行うことができないものであった。尚、多数の発光ダイオードを、隣り合う発光ダイオードとの隙間が極力小さな密の状態で配置したとしても、前記不都合を解消することができないものであり、改善の余地があった。
【０００４】本発明が前述の状況に鑑み、解決しようとするところは、暗くなる箇所が発生することなく、どの箇所においても均等に照らすことができる検査用照明装置を提供する点にある。
【０００５】
【課題を解決するための手段】本発明は、前述の課題解決のために、多数の発光体が線状に配置された線状光源の光照射側に集光手段を配置してなる照明部の複数のそれぞれを、検査対象物のほぼ同一箇所に対して照射し、該照明部の各発光体が検査対象物を照射するそれぞれの位置と該別の照明部の各発光体が検査対象物を照射するそれぞれの位置とが照射する線状の発光体群の長手方向において異なるように該複数の照明部の各発光体を配置して、検査用照明装置を構成した。従って、複数の照明部からの光は、シリンドリカルレンズ等の集光手段により集光されて帯状の光に変換されて検査対象物のほぼ同一箇所に照射される。そして、前記複数の照明部の各発光体からの光は、図４に示すように照射される。つまり、特定の照明部の各発光体からのほぼ円形の光Ｈ１，Ｈ１同士間に、別の照明部の各発光体からの光Ｈ２が一部重複した状態で照射されることにより、ほぼ帯状の光（ドットで囲まれる範囲）になり、図１４で示した上下の暗い箇所Ｂ，Ｂを無くしてどの箇所においても明るさがほぼ均等になるように構成することができる。図４及び図１４に示すＨ３，Ｈ４は、前記光Ｈ１，Ｈ２の両外側に発生する光であり、この範囲において検査することがなく、実際には前記光Ｈ１，Ｈ２により描かれる帯状の光によって検査されることになる。尚、前記検査対象物を反射した光を例えばラインセンサカメラ等の撮像手段にて撮像し、その撮像された画像を処理する画像処理装置などを設けて自動的に検査を行うように構成する他、ハーフミラーの上方から場合によっては目視により検査を行うこともできる。本発明の検査用照明装置は、反射光により検査対象物を検査するものにおいて最適であるが、紙やプラスチック等でなる検査対象物に照射した光が検査対象物を透過し、その透過光から異物検出等を行う場合にも用いることができる。図１では、検査対象物の検査面（表面）に対して垂直となる垂線Ｔを挟んで両側にそれぞれ、照明部を３列設けたものを示し、１列や２列のものに比べて光量の増大を図る利点があるが、１列や２列設けて実施することもできるし、４列以上設けて更に光量を増大させるようにしてもよい。前記照明部を複数列設ける場合には、全ての照明部の各発光体の照射位置が線状に配置された発光体群の長手方向で異なるように全ての発光体を配置することにより該長手方向のどの箇所においても明るさが均等になる効果を一層高めることができるのであるが、一部の照明部の各発光体の照射位置のみが残る他の照明部の各発光体の照射位置と異なるように全ての発光体を配置してもよい。前記照射位置を異ならせる手段として、全ての照明部の各発光体同士のピッチを同一に設定し、全ての照明部のうちの一部又は全部の照明部の各発光体の照射位置が発光体配置方向（前記発光体群の長手方向）で異なるように一部又は全部の照明部をずらして配置したり、特定の照明部の各発光体同士のピッチを他の照明部の各発光体同士のピッチと異ならせることにより一部又は全部の照明部の各発光体の照射位置が他の照明部の各発光体の照射位置と発光体配置方向で異なるようにしてもよい。
【０００６】前記照明部の複数のそれぞれを、検査対象物の表面に対して垂直となる垂線を挟んで両側に振り分けて該検査対象物のほぼ同一箇所に対して異なる斜め方向から照射するように配置している。
【０００７】前記両側に振り分けた複数の照明部のうちの一方側に振り分けられた照明部が、検査対象物のほぼ同一箇所に対して照射するように前記線状光源を複数配置したものから構成することによって、光量を増大させることができる。
【０００８】前記線状光源を構成する各発光体のピッチをどの線状光源においても同一ピッチに構成し、前記特定の線状光源を構成する各発光体同士間に前記残りの他の特定の線状光源を構成する各発光体が位置するように、該特定の線状光源に対して該残りの他の特定の線状光源の位置を、該特定の線状光源から該残りの他の特定の線状光源を見たときの方向においてずらせることによって、前記のように一方側に位置する照明部の各発光体からの検査対象物に対する照射位置と他方側に位置する照明部の各発光体からの検査対象物に対する照射位置とを発光体の配置方向において異ならせて、前述のように照明部の各発光体からの光が一部重複した状態で照射されることになる。
【０００９】前記発光体を発光ダイオード又はチップ型発光ダイオードから構成することによって、各種ランプにより構成した場合に比べて消費電力及び発熱面において有利になるだけでなく、寿命が飛躍的に長く、劣化スピードが遅い利点がある。尚、砲弾型の発光ダイオードを用いる場合が、チップ型発光ダイオードの場合に比べて集光手段により有効に集光させることができる利点が

ある。

【００１０】前記両側に振り分けた照明部同士間に形成される隙間を通して下方に位置する検査対象物に対して垂直方向から光を照射するために、該隙間の上方箇所に配置したハーフミラーに集光手段を介在して照射する多数の発光体が前記発光体の配置方向とほぼ平行の線状に配置された第２線状光源からなる第２照明部を配置している。上記のように構成することによって、第２照明部からの光は、シリンドリカルレンズ等の集光手段により集光されて帯状の光に変換されて検査対象物に対して垂直方向から照射し、検査面がフラットな場合でも良好な検査を行うことができる。

【００１１】多数の発光体が線状に配置された線状光源の光照射側に集光手段を配置して構成してなる照明部の複数のそれぞれを、検査対象物の表面に対して垂直となる垂線を挟んで両側に振り分けて検査対象物のほぼ同一箇所に対して異なる斜め方向から照射するように配置し、前記両側に振り分けた照明部同士の隙間を通して下方に位置する検査対象物に対して垂直方向から光を照射するために、該隙間の上方箇所に配置したハーフミラーに集光手段を介在して照射する多数の発光体が前記発光体の配置方向とほぼ平行の線状に配置された第２線状光源からなる第２照明部を配置し、少なくとも前記特定の第１照明部の各発光体が検査対象物を照射するそれぞれの位置と前記第２照明部の各発光体が検査対象物を照射するそれぞれの位置とが異なるように該第１照明部の各発光体と該第２照明部の各発光体を配置して、検査用照明装置を構成することもできる。従って、一部（特定）又は全部の照明部の各発光体からの検査対象物に対する照射位置と第２照明部の各発光体からの検査対象物に対する照射位置とを異ならせることによって、照明部の各発光体からの光と第２照明部の各発光体からの光とが一部重複した状態で照射されることになる。又、一部（特定）の照明部の各発光体からの検査対象物に対する照射位置と残りの照明部の各発光体からの検査対象物に対する照射位置とを異ならせることによって、照明部の各発光体からの光の一部が重複した状態で照射されることになる。又、第２照明部を複数列設ける場合には、一部の第２照明部の各発光体からの検査対象物に対する照射位置と残りの第２照明部の各発光体からの検査対象物に対する照射位置とを異ならせることによって、第２照明部の各発光体からの光の一部が重複した状態で照射されることになる。

【００１２】前記集光手段と検査対象物との間に、前記発光体からの光を拡散させるための拡散板を配置している。集光手段により集光させている関係上、角度の異なる複数の照明部の発光体からの光のうち、特定の照明部の発光体からの正反射した強い光（発光体の光軸付近の光）を撮像手段に取り込むことができるのであるが、別の他の照明部の発光体からの正反射した強い光は、前記撮像手段に取り込むことができず、複数の照明部にて照明しているにも係わらず、撮像手段へ取り込まれる光が暗くなってしまう。そこで、上記のように拡散板を設けることによって、取り込むことができなかった別の他の照明部の発光体からの光をも撮像手段に取り込むことができることから、撮像手段へ取り込まれる光を明るくすることができる。

【００１３】前記照明部の複数のそれぞれを、該照明部同士間に隙間が発生する状態で検査対象物の表面に対して垂直となる垂線を挟んで両側に配置し、前記照明部から照射されて検査対象物の表面を反射した反射光を前記照明部同士間の隙間を通して認識可能に構成している。

【００１４】多数の発光体が線状に配置された線状光源の光照射側に集光手段を配置し、その集光手段の前方又は後方に、前記線状光源からの光を発光体の配置方向に拡散させるための拡散手段を設けて、検査用照明装置を構成してもよい。上記のように拡散手段を集光手段の前方又は後方に設けることによって、各発光体からの光が集光される前、又は集光された後に発光体の配置方向に拡散され、例えばバックライトとして直接光源を写したり、光沢面を有する検査対象物の光沢面に正反射させて見る場合、発光ダイオード等の発光体の球が直接見え、発光体と発光体の間が光が途切れてしまうという現象を解消することができる。具体的には、図２０（ａ）に示すように、検査対象物１が紙の場合には、発光ダイオード２５から紙１に照射して反射してきた光ｈを肉眼Ｉで見ると、発光ダイオード２５の球が直接見えることがなく、帯状に形成された状態の光ｈを見ることができるが、図２０（ｃ）に示すように、検査対象物１が鏡面である場合には、肉眼Ｉで見たとき、発光ダイオード２５の球が直接見え、発光ダイオード２５と発光ダイオード２５の間が光が途切れてしまうという現象を発生することになり、これを前記のように拡散手段を用いることによって、解消することができるのである。そして、図２０（ｂ）に示すように、バックライトとして直接光源を写す場合に、拡散板等からなる拡散手段２８を用いることによって、図２０（ｃ）で示した発光ダイオード２５の球が粒だって見えるぶつぶつ状態ではなく、それら球が連なった帯状に見えることになる。この場合、照明部が単一であってもよいし、又、明るさを上げるために複数設けて実施することもできる。前記拡散手段としては、表面に発光体の配置方向と直交する一方向に沿う各種の形状の凸部の多数を該発光体の配置方向に沿って形成したり、透明体の内部に光ファイバー等の拡散部材を備えたもので構成することができる。尚、図２０（ａ），（ｂ），（ｃ）は、集光手段を省略したものである。

【００１５】

【発明の実施の形態】図１に、検査対象物としてのプリント基板１の表面の凹凸や図示していないハンダ付けし

た箇所等を検査するために照明することができる検査用照明装置が示されている。この検査用照明装置は、下方が開放された矩形状で箱形のケーシング２内に、プリント基板１の偏平な検査面（表面）に対して垂直となる垂線Ｔを挟んで両側に振り分けてプリント基板１のほぼ同一箇所に対して異なる斜め方向から照射する照明部である第１照明部３の２つ（３つ以上であってもよい）を配置している。ここでは、検査対象物の表面を反射した反射光を取り込んで検査を行う表面検査用照明装置を示しているが、透明又は半透明な材料でなる検査対象物を透過した透過光を取り込んで、異物検出などを行う場合に用いる検査用照明装置であってもよい。前記検査対象物に反射した反射光を、上板部５の長孔５Ａ（図８参照）の上方に配置したラインセンサカメラ（図示せず）にて捉えた画像を図示していない画像処理装置により画像処理し、その画像の良否をコンピュータにより判定したり、モニター等に映し出して人間が良否を判定するようにしてもよい。尚、場合によっては、前記ラインセンサカメラを省略し、目視により検査対象物を検査する構成であってもよい。

【００１６】前記第１照明部３，３は、図１に示すように、前記長孔５Ａの幅（長手方向と垂直となる方向の大きさ）とほぼ同一の大きさの寸法の隙間Ｓを開けて配置され、隙間Ｓから離れる側ほど下方に位置する傾斜姿勢、つまり側面視においてハの字型をなすように配置されている。前記第１照明部３，３のそれぞれは、同一構成であるため、一方の第１照明部３のみ説明する。前記第１照明部３は、斜め方向に所定間隔をおいて配設された３つの発光ダイオードＶＬ１，ＶＬ２，ＶＬ３のそれぞれが図１では紙面と直交する方向に線状に多数配置された３列の第１線状光源１４，１４，１４を基板１５Ｌ（他の基板１５Ｒには、ＶＲ１，ＶＲ２，ＶＲ３が取り付けられている）に取り付けると共に、それら各第１線状光源１４の光側に該発光ダイオードＶＬ１，ＶＬ２，ＶＬ３とほぼ平行に３つの集光手段としてのシリンドリカルレンズ（集光させることができるものであればどのようなものでもよい）１６，１６，１６を透明な支持板１６Ａを介して配置して、構成されている。尚、前記３つのシリンドリカルレンズ１６，１６，１６と前記支持板１６Ａとを一体形成したものを用いてもよい。

【００１７】図２に示すように、３列の第１線状光源１４，１４，１４のうちの中央に配置された第１線状光源１４の各発光ダイオードＶＬ２の光軸１３Ａに、これに対応して配置した前記シリンドリカルレンズ１６の中心部を合致させた状態にし、前記中央に位置する第１線状光源１４に対して両側に位置する２列の第１線状光源ＶＬ１，ＶＬ３までの距離（第１線状光源１４，１４同士間の距離（ピッチ））Ｐ１に対して、前記中央に位置するシリンドリカルレンズ１６に対して両側に位置するシリンドリカルレンズ１６，１６までの距離（シリンドリカルレンズ１６，１６同士間の距離（ピッチ））Ｐ２を小さくすることによって、３つのシリンドリカルレンズ１６，１６，１６からの光軸１３Ａ，１３Ａ，１３Ａを一箇所に集光させることができるようにしているが、発光ダイオードＶＬ１，ＶＬ２，ＶＬ３に対するシリンドリカルレンズ１６，１６，１６の位置はどれも同じにして、中央に位置する発光ダイオードＶＬ２及びシリンドリカルレンズ１６に対して、両側に位置する発光ダイオードＶＬ１，ＶＬ３及びシリンドリカルレンズ１６，１６の角度を変更することにより、３つのシリンドリカルレンズ１６，１６，１６からの光軸１３Ａ，１３Ａ，１３Ａを一箇所に集光させることができるようにしてもよい。この場合、発光ダイオードＶＬ１，ＶＬ２，ＶＬ３に対する基板１５Ｌを別々のもので構成してもよい。

【００１８】前記同一ピッチで同一の取り付け位置に取り付けられた発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３の配置状態を図３に示し、それら発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３による光の状態を図５に示している。つまり、左側に位置する基板１５Ｌ（図３では下側に配置している）に取り付けられた３列の第１線状光源１４の長手方向で隣り合う発光ダイオードＶＬ１，ＶＬ２，ＶＬ３からの検査対象物に対する光Ｈ１，Ｈ１の間に右側に位置する基板１５Ｒ（図３では上側に配置している）に取り付けられた３列の第１線状光源１４の長手方向に沿って配置された各発光ダイオードＶＲ１，ＶＲ２，ＶＲ３からの検査対象物に対する光Ｈ２が重複して位置するように、左側の基板１５Ｌに対して右側の基板１５Ｒの位置を一方の基板１５Ｌから他方の基板１５Ｒを見たときの方向において発光ダイオード１３，１３同士のピッチ（間隔）の半ピッチ分だけ移動させた位置に位置させて、帯状に照射される光がどの箇所においても暗い箇所のない均一な光量になるようにしている。図３では、前記左右の基板１５Ｌ，１５Ｒの位置をずらしたが、一方の基板１５Ｌ内に配置する発光ダイオードＶＬ１，ＶＬ２，ＶＬ３の取付位置と他方の基板１５Ｒ内に配置する発光ダイオードＶＲ１，ＶＲ２，ＶＲ３の取付位置とを異ならせる（ずらす）ことによって、前記のように帯状に照射される光がどの箇所においても暗い箇所のない均一な光量になるように構成してもよい。図では、３列の第１線状光源１４を示しているが、１列又は２列あるいは４列以上の第１線状光源を設けて実施することもできる。又、複数列の第１線状光源１４を同一の基板１５Ｌ又は１５Ｒに取り付ける他、一列ずつ専用の基板に取り付けて実施することもできる。

【００１９】前記発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３を、図４に示すように配置して実施することもできる。前記左側に位置する基板１５Ｌ（図４では下側に配置している）に、発光ダイオードＶＬ１，ＶＬ２，ＶＬ３のそれぞれを同一ピッチＰＡ

で、かつ、各発光ダイオードの配置方向（発光ダイオード群の長手方向）と直交する方向において異なるように取り付けている。又、前記右側に位置する基板１５Ｒ（図４では上側に配置している）に、発光ダイオードＶＲ１，ＶＲ２，ＶＲ３を同一ピッチＰＡで、かつ、各発光ダイオードの配置方向と直交する方向において異なるように取り付けている。尚、発光ダイオードＶＬ２とＶＲ３とが発光ダイオードの配置方向発光ダイオード群の長手方向）と直交する方向において同一位置になっているが、異ならせて実施することもできる。前記のように発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３を配置することによって、左側の発光ダイオードＶＬ１，ＶＬ２，ＶＬ３から右側の発光ダイオードＶＲ１，ＶＲ２，ＶＲ３を見たときに、両者の取り付け位置が一部重複するものの、ほとんどが異なる状態となり、これら発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３を照射したときの光が一部重複させることができる、例えばＶＬ２とＶＬ３やＶＬ３とＶＲ１との間で重複させることができるようにしている。尚、発光ダイオードの配置を分かり易くするために図４、後述する図１１、図１２では、発光ダイオードの間を大きく空けた状態を示したが、実際には図３のように肉眼では密の状態に配置されていることになる。

【００２０】図６に示すように、前記ケーシング２の下面開口部を中心部にプリント基板１からの反射光を通過させるための貫通孔Ｋ１が形成された拡散板Ｋを設けて実施することによって、発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３からの光の照射ムラを緩和することができ、プリント基板１に照射され、反射してきた該光をできるだけ垂線Ｔに沿って上方の撮像手段に取り込むことができるように構成してもよい。前記拡散板Ｋを設けることにより、輝度がほぼ半分に下がると仮定すると、６列の発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３では、３列の発光ダイオードの光の輝度しか得られないが、前記のように反射してきた該光をできるだけ垂線Ｔに沿って上方の撮像手段に取り込むことができることから、実際には拡散板Ｋを設けた場合の方が拡散板Ｋを設けない場合に比べて照射ムラ及び取り込まれる光の明るさにおいて有利になる。又、前記拡散板Ｋを薄くしてプリント基板１にできるだけ近づけることによって、照射ムラ及び取り込まれる光の明るさにおいて更に有利にすることができる。しかも、前記のように左側の発光ダイオードＶＬ１，ＶＬ２，ＶＬ３から右側の発光ダイオードＶＲ１，ＶＲ２，ＶＲ３を見たときに、両者の取り付け位置が一部重複するものの、ほとんどが異なる状態とすることによって、前記照射ムラにおいて更に有利になる。前記斜めに配置された発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３に対して拡散板Ｋを水平に配置したが、拡散板Ｋも発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３と平行になるように斜めに配置してもよい。

【００２１】前記拡散板Ｋを設けた場合と拡散板Ｋを設けていない場合の違いについて簡単に説明すれば、図７（ａ）に示すように、図示していない検査対象物に対して垂直となる垂線Ｔに対して図の左側に角度θだけ傾けた位置に撮像手段２３を設け、図の右側に発光ダイオード２２，２２が前記と同様に紙面に対して垂直な方向に多数取り付けられた線状光源の２列（説明を簡単にするためにここでは２列を示しているが、１列又は３列以上であってもよい）を配置し、それら線状光源の照射面側にシリンドリカルレンズ１６を配置したものを示している。図において右側の線状光源が前記垂線Ｔに対して右側に角度θだけ傾けた位置に配置している。従って、それぞれの発光ダイオード２２，２２から検査対象物の偏平な検査面に照射された光のうち、右側の発光ダイオード２２からの直接反射光（正反射光）のみが、撮像手段２３に取り込まれるが、左側の発光ダイオード２２からの直接反射光（正反射光）は取り込めない。そのため、撮像手段２３に１つの線状光源からの光しか取り込めず、暗くなってしまうのに対して、図７（ｂ）に示すように、拡散板Ｋを配置することによって、全ての線状光源からの光を撮像手段２３に少なからず反映させることができ、図７（ａ）のように暗くなることを回避することができる。尚、線状光源の個数が多くなればなるほど拡散板Ｋを設けることによる効果が顕著になる。図５、図１３、図１４は、線状光源の直接反射光（正反射光）を示すものではなく、プリント基板１の表面で散乱した散乱光を示したものである。

【００２２】図１では、第１照明部３，３のみで検査用照明装置を構成することによって、小型化を図ることができる利点があるが、図８～図１０に、第２照明部４を設けたものであってもよい。この検査用照明装置は、下方が開放された矩形状で箱形のケーシング２内に、プリント基板１の検査面に対して垂直となる垂線Ｔを挟んで両側に振り分けてプリント基板１のほぼ同一箇所に対して異なる斜め方向から照射する照明部である第１照明部３の２つ（３つ以上であってもよい）及び第２照明部４を収納して構成されている。前記ケーシング２は、前後方向ほぼ中央に左右方向に長い検査用の長孔５Ａが形成された上板部５と、左右を覆う左右板部６，７と、前後を覆う前後板部８，９からなっているが、図に示される構成以外のものであってもよい。図８及び図９に示す１０，１１，１２は、前記第１照明部３，３及び第２照明部４に電力を供給するためのケーブルである。ここでは、一対の第１照明部３，３及び第２照明部４を備えたものを示しているが、第２照明部４を省略して、一対の第１照明部３，３のみを設けたもので構成してもよい。前述同様に、前記検査対象物に反射した反射光を、上板部５の長孔５Ａの上方に配置したラインセンサカメラ

（図示せず）にて捉えた画像を図示していない画像処理装置により画像処理し、その画像の良否をコンピュータにより判定したり、モニター等に映し出して人間が良否を判定するようにしてもよい。尚、場合によっては、前記ラインセンサカメラを省略し、目視により検査対象物を検査する構成であってもよい。

【００２３】図１１に示すように、前記左側に位置する基板１５Ｌ（図１１では下側に配置している）に、発光ダイオードＶＬ１，ＶＬ２，ＶＬ３のそれぞれを同一ピッチＰＡで、かつ、各発光ダイオードの配置方向と直交する方向において異なるように取り付けている。又、前記右側に位置する基板１５Ｒ（図１１では上側に配置している）に、発光ダイオードＶＲ１，ＶＲ２，ＶＲ３を同一ピッチＰＡで、かつ、各発光ダイオードの配置方向と直交する方向において異なるように取り付けている。尚、発光ダイオードＶＬ２とＶＲ３とが発光ダイオードの配置方向と直交する方向において同一位置になっているが、異ならせて実施することもできる。前記のように発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３を配置することによって、左側の発光ダイオードＶＬ１，ＶＬ２，ＶＬ３から右側の発光ダイオードＶＲ１，ＶＲ２，ＶＲ３を見たときに、両者の取り付け位置が一部重複するものの、ほとんどが異なる状態となり、これら発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３を照射したときの光が一部重複させることができる、例えばＶＬ２とＶＬ３やＶＬ３とＶＲ１との間で重複させることができるようにしている。図１１に示す１９は、前記第２照明部４の発光ダイオードを示し（第１照明部の発光ダイオードと容易に区別するために四角形にて表示している）、前記発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３と同一ピッチにしているが、異なるピッチであってもよい。又、図１２では、前記第１照明部３の発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３は、図１１と同様であるが、前記第２照明部４の発光ダイオード１９の取り付け位置のみ変更した場合を示している（第１照明部の発光ダイオードと容易に区別するために四角形にて表示している）。

【００２４】前記全ての発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３の照射位置が同一箇所になるように発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３の取り付け位置を発光ダイオードの配置方向と直交する方向で同一に設定し、前記発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３の照射位置と前記第２照明部４の発光ダイオード１９の照射位置とが発光ダイオードの配置方向において異なるように配置して実施してもよい。この場合、図１３に示すように、発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３の光同士Ｈ１（Ｈ２），Ｈ１（Ｈ２）間に発光ダイオード１９の光Ｈ５が重複した状態で照射されることになり、暗くなる箇所が発生することを抑制することができる。

【００２５】前記第２照明部４は、前記一対の第１照明部３，３同士の隙間Ｓを通して下方に位置する検査対象物１に対して垂直方向から光を照射するように構成されており、具体的には、図８～図１０に示すように、隙間Ｓの上方箇所、換言すれば長孔５Ａの下方箇所に配置したハーフミラー１７とこのハーフミラー１７へ集光手段としてのシリンドリカルレンズ（集光させることができるものであればどのようなものでもよい）１８を介在して照射する多数の発光ダイオード１９が前記発光ダイオード１３の配置方向とほぼ平行の線状に基板２０を介して配置された第２線状光源２１とからなっている。図では、発光ダイオード１９を一列のみ設けて実施しているが、複数列設けて実施することもできる。

【００２６】前記発光ダイオード１３として、砲弾型のものを用いる場合が集光させる場合に有効であるが、実装密度を高めることができるチップ型の発光ダイオードであってもよい。

【００２７】前記検査用照明装置を、図１４（ａ），（ｂ）に示すように構成することもできる。つまり、一方側が開放された箱型のケーシング２４の内部に、一直線上に所定間隔を置いて多数の発光ダイオード２５の多数が支持された基板２６と、前記発光ダイオード２５からの光を発光ダイオード２５の配置方向Ｘに拡散させるための拡散手段としての拡散板（透明なアクリル板等で構成してもよいし、シート上のものでもよい）２８と、この拡散板２８にて拡散した光を集光させるためにケーシング２４の開放端に位置させた集光手段としてのシリンドリカルレンズ２７とを配置している。ここでは、拡散板２８をシリンドリカルレンズ２７の後方、つまり発光ダイオード２５側の後（背）面に接近又は接触した状態で配置しているが、図１５に示すように、発光ダイオード２５側の後方位置のうちの後（背）面以外の位置（図では後面を含めて全部で３つの位置を示しているが、図に示す位置以外でもよい）に拡散板２８を配置してもよいし、又、シリンドリカルレンズ２７の前方に拡散板２８を配置して実施することもできるし、場合によっては、シリンドリカルレンズ２７の前方及び後方の両方に配置してもよい。前記拡散板２８の透過率は、８０％以上に設定することが光の透過による明るさの低下を招くことが少なく好ましい。

【００２８】前記拡散板２８は、例えば図１６に示すように、前記発光ダイオード２５からの光が入射する表面（上面）に前記発光ダイオード２５の配置方向Ｘに沿って断面形状がほぼ半円状の凸部２８ａの多数を形成したもので構成されている。そして、前記各凸部２８ａは、前記発光ダイオード２５の配置方向Ｘと直交する方向（紙面と直交する方向）に長い形状に構成されている。このように構成された拡散板２８に前記発光ダイオード

２５から入射してきた光（図面において下方から入射する光）が表面から前記配置方向Ｘに拡散するようになっている。前記凹凸の形状として、例えば図１７に示すように、断面形状が波形状、つまり半円状の凸部２８Ａと半円状の凹部２８Ｂとが前記配置方向Ｘに交互に位置する形状であってもよい。

【００２９】前記拡散手段としては、前記のように拡散板２８の表面（光入射側面）に、発光ダイオード２５の配置方向Ｘと直交する一方向に沿う各種の形状の凸部の多数を該発光ダイオード２５の配置方向Ｘに沿って形成したものの他、図１８（ａ）に示すように、透明体の内部に、光ファイバー等の円柱状（形状はどのような形状でもよい）の拡散部材２９を等間隔を置いて前記発光ダイオード２５の配置方向Ｘに沿って備えさせたものから拡散板２８を構成してもよい。又、図１８（ｂ）では、図１８（ａ）で示した拡散部材２９の他に直径の異なるもう１種類（２種類以上であってもよい）を透明体の内部に備えさせる、つまり２種類の拡散部材２９，３０を前記発光ダイオード２５の配置方向Ｘに沿って交互に備えさせて拡散板２８を構成したものを示し、又、図１８（ｃ）では、光ファイバー等の円柱状（形状はどのような形状でもよい）の拡散部材３１を表面（上面）に一部が突出した状態で、かつ、隣り合う拡散部材３１，３１同士間に隙間の無い密の状態で備えさせて拡散板２８を構成したものを示している。

【００３０】このように図１６～図１８の拡散板２８を用いることによって、前記発光ダイオード２５から拡散板２８、シリンドリカルレンズ２７を介して検査対象物１に照射される光ｈが、図１９に示すように拡散されることになる。そして、図２０（ｂ）に示すように、バックライトとして直接光源を写したり、図２０（ｃ）に示すように、光沢面を有する検査対象物１の光沢面に正反射させて見る場合、発光ダイオード２５の球が直接見え、発光ダイオード２５と発光ダイオード２５の間が光が途切れてしまうという現象を解消することができるのである。尚、前記拡散板２８を用いないで照射した比較例として図２０（ｃ）に示している。又、前記拡散板（手段）２８を、図１や図８の検査用照明装置に取り付けて実施することもできる。図１や図８の場合には、前述のように、照明部３の各発光ダイオードＶＬ１，ＶＬ２，ＶＬ３が検査対象物１を照射するそれぞれの位置と別の照明部３の各発光ダイオードＶＲ１，ＶＲ２，ＶＲ３が検査対象物１を照射するそれぞれの位置とが照射する線状の発光ダイオード群の長手方向において異なるように該複数の照明部３，３の各発光ダイオードＶＬ１，ＶＬ２，ＶＬ３、ＶＲ１，ＶＲ２，ＶＲ３を配置しているから、暗い箇所が発生することがなく、どの箇所においても均等に照らすことができるという利点（効果）があり、拡散板２８の拡散作用との相乗効果によりその利点をより一層顕著にすることができる。

【００３１】

【発明の効果】請求項１の発明によれば、複数の照明部からの光により検査面がフラットでない検査対象物に対して帯状に照射することによって、特にハンダ付けした箇所等のような形状のものでも、良好な検査が行える検査用照明装置を提供することができる。しかも、複数の照明部からの照射位置を変更するだけで、暗い箇所が発生することがなく、どの箇所においても均等に照らすことができる検査用照明装置を構成することができる。

又、検査対象物を透過した透過光を取り込んで異物検査等を行う場合においても前記同様の効果を得ることができる。又、請求項１０のように、多数の発光体が線状に配置された線状光源の光照射側に集光手段を配置し、その集光手段の前方又は後方に、線状光源からの光を発光体の配置方向に拡散させるための拡散手段を設けることによって、バックライトとして直接光源を写したり、光沢面を有する検査対象物の光沢面に正反射させて見る場合、発光ダイオード等の発光体の球が直接見え、発光体と発光体の間が光が途切れてしまうという現象を解消することができる、つまり請求項１と同様に、暗い箇所が発生することがなく、どの箇所においても均等に照らすことができる効果を得ることができる。又、請求項１のように発光体の配置を変更することが不要であり、既存の検査用照明装置に拡散手段を取り付けるだけの簡単な改造で前記効果を奏することができる利点がある。

【００３２】請求項３の発明によれば、両側に振り分けた複数の照明部のうちの一方側に振り分けられた照明部が、検査対象物のほぼ同一箇所に対して照射するように前記線状光源を複数配置したものから構成することによって、光量を増大させることができ、見つけにくい小さな傷を検査する場合等において有利になり、検査対象物の拡大を図ることができる。

【００３３】請求項５の発明によれば、発光体を発光ダイオード又はチップ型発光ダイオードから構成することによって、各種ランプにより構成した場合に比べて消費電力及び発熱面において有利になるだけでなく、寿命が飛躍的に長く、劣化スピードが遅い利点がある。しかも、チップ型発光ダイオードの場合には、砲弾型の発光ダイオードに比べて実装密度を高めることができ、どの箇所においても光度を均一にすることができる効果を更に高めることができる。

【００３４】請求項６の発明によれば、第２照明部を配置することによって、検査対象物に対して垂直方向から照射することができるから、検査面がフラットな場合でも良好な検査を行うことができ、前記一対の照明部と併用することにより、どのような形状の検査対象物であっても、良好な検査を行うことができる検査用照明装置を提供することができる。又、検査対象物を透過した透過光を取り込んで異物検査等を行う場合においても有効になる。

【００３５】請求項７の発明によれば、請求項５と同様に、第２照明部を配置することによって、検査対象物に対して垂直方向から照射することができるから、検査面がフラットな場合でも良好な検査を行うことができ、前記一対の照明部と併用することにより、どのような形状の検査対象物であっても、良好な検査を行うことができるものでありながら、照明部の各発光体の配置を変更する、又は第２照明部の各発光体の配置を変更する、又は照明部の各発光体と第２照明部の各発光体の配置を変更することによって、請求項１と同様に、暗い箇所が発生することがなく、どの箇所においても均等に照らすことができ、検査用照明装置の設計の自由度を高めることができる利点がある。又、検査対象物を透過した透過光を取り込んで異物検査等を行う場合においても有効になる。

【００３６】請求項８の発明によれば、集光手段と検査対象物との間に、前記発光体からの光を拡散させるための拡散板を配置することによって、取り込むことができない照明部からの光をも取り込むことができ、検査精度を高めることができる利点がある。前記照明部の個数が多ければ多いほど取り込むことができる光量を増大させることができる。

【図面の簡単な説明】

【図１】検査用照明装置の縦断側面図である。

【図２】発光ダイオードとシリンドリカルレンズの取り付け部の構造を示す要部の説明図である。

【図３】図１の照明装置の発光ダイオードの配置を示す説明図である。

【図４】発光ダイオードの他の配置を示す説明図である。

【図５】図１で示した第１照明部の発光ダイオードによる光の画像サンプルを示す説明図である。

【図６】拡散板を取り付けた別の検査用照明装置の縦断側面図である。

【図７】撮像手段と発光ダイオードの別の配置を示し、（ａ）は拡散板のない場合を示し、（ｂ）は拡散板のある場合を示している。

【図８】別の検査用照明装置の縦断側面図である。

【図９】別の検査用照明装置の平面図である。

【図１０】別の検査用照明装置の縦断側面図である。

【図１１】図８の照明装置の発光ダイオードの配置を示す説明図である。

【図１２】図８の照明装置の発光ダイオードの別の配置を示す説明図である。

【図１３】第１照明部の光と第２照明部の光とが重複している状態の画像サンプルを示す説明図である。

【図１４】別の検査用照明装置を示し、（ａ）は発光ダイオードの配置方向で切断した断面図、（ｂ）は発光ダイオードの配置方向と直交する方向で切断した断面図である。

【図１５】図１４の照明装置に３枚の拡散板を備えさせた断面図である。

【図１６】別の拡散板の断面図である。

【図１７】別の拡散板の断面図である。

【図１８】（ａ），（ｂ），（ｃ）は別の拡散板の断面図である。

【図１９】図１４で示した検査用照明装置を用いて照射したときの光の画像サンプルを示す説明図である。

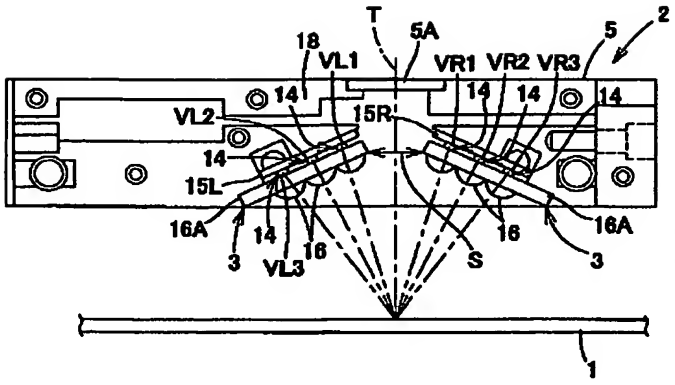
【図２０】（ａ），（ｂ），（ｃ）は、発光ダイオードからの光を見たときの光の状態を示す説明図である。

【図２１】従来の照明部による光の画像サンプルを示す説明図である。

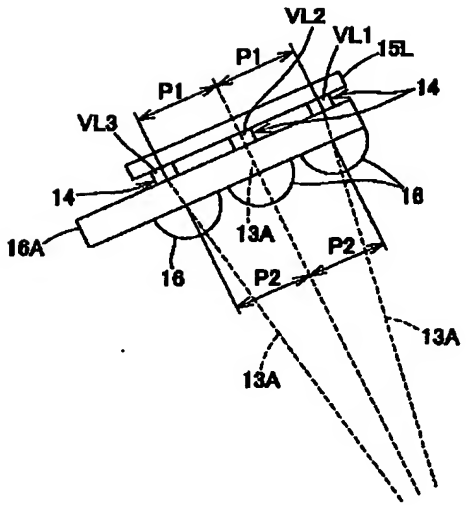
【符号の説明】

１　プリント基板（検査対象物）
２　ケーシング　　３　第１照明部
４　第２照明部　　５　上板部
５Ａ　長孔　　６，７　左右板部
８，９　前後板部　　１０，１１，１２　ケーブル
１３Ａ　光軸　　１４　第１線状光源
１５Ｌ，１５Ｒ　基板　　１６　シリンドリカルレンズ
１６Ａ　支持板　　１７　ハーフミラー
１８　シリンドリカルレンズ
１９　発光ダイオード　　２０　基板
２１　第２線状光源　　２２　発光ダイオード
２３　撮像手段　　２４　ケーシング
２５　発光ダイオード　　２６　基板
２７　シリンドリカルレンズ（集光手段）
２８　拡散板（拡散手段）
２８Ａ　凸部　　２８Ｂ　凹部
２８ａ　凸部
２９～３１　拡散部材　　３２，３３　領域
Ｈ１，Ｈ２，Ｈ３，Ｈ４　光
Ｐ１，Ｐ２，ＰＡ　ピッチ
Ｋ　拡散板　　Ｋ１　貫通孔
Ｓ　隙間　　Ｔ　垂線
ＶＬ１，ＶＬ２，ＶＬ３　発光ダイオード
ＶＲ１，ＶＲ２，ＶＲ３　発光ダイオード
Ｘ　発光ダイオードの配置方向

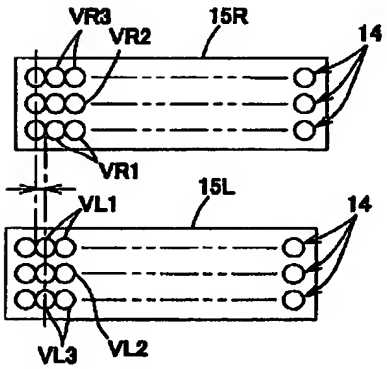
【図１】



【図２】



【図３】



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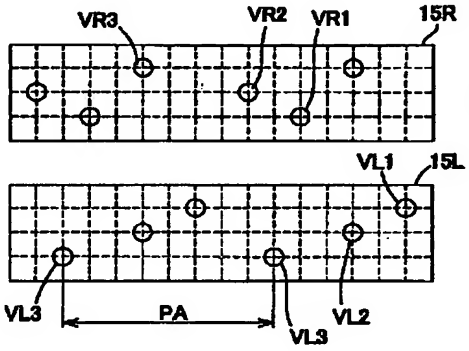

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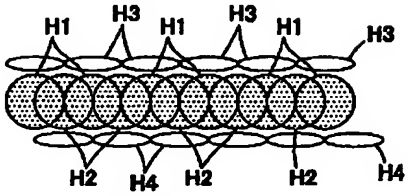
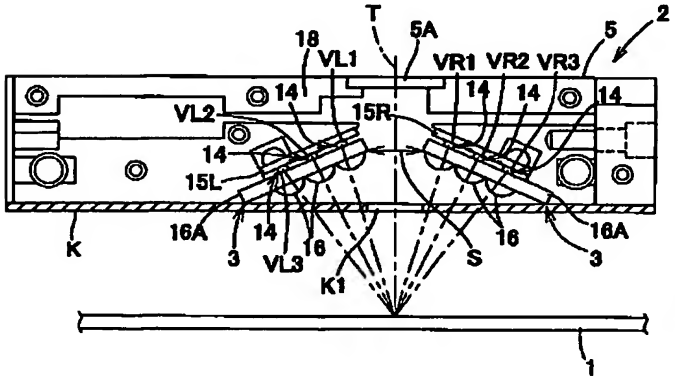
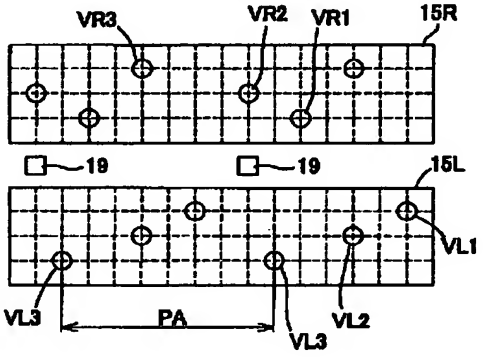


【図６】



【図１１】



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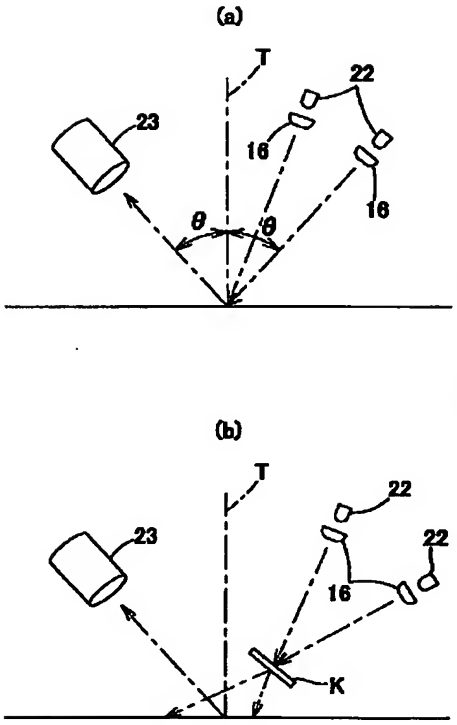

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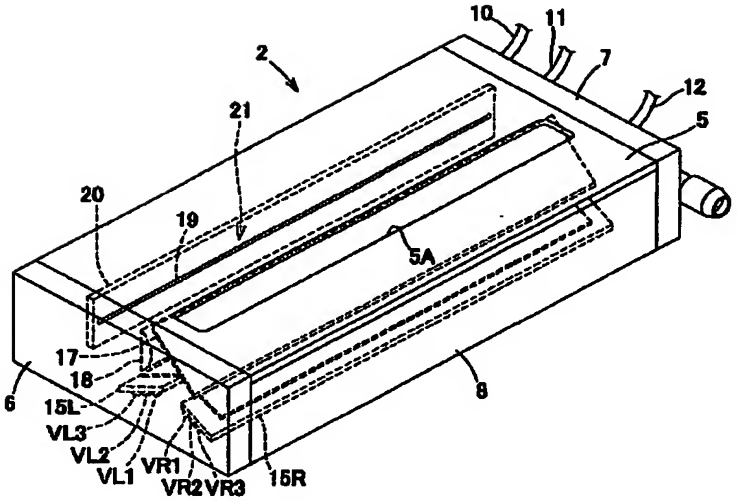

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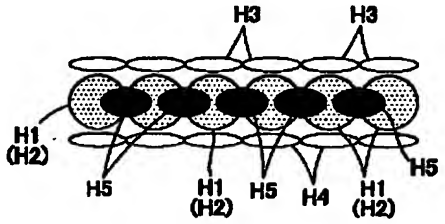

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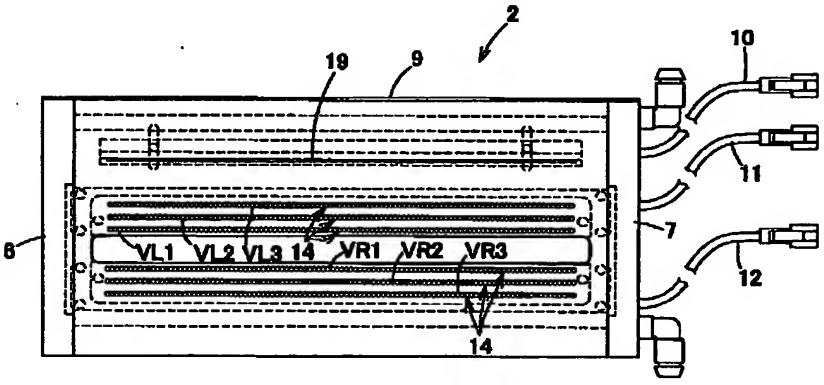

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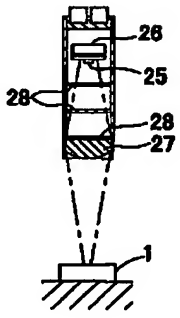
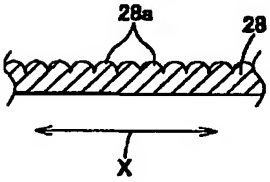
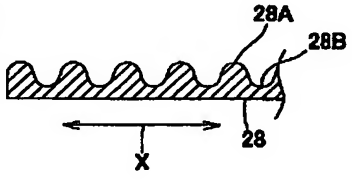


【図１６】



【図１７】



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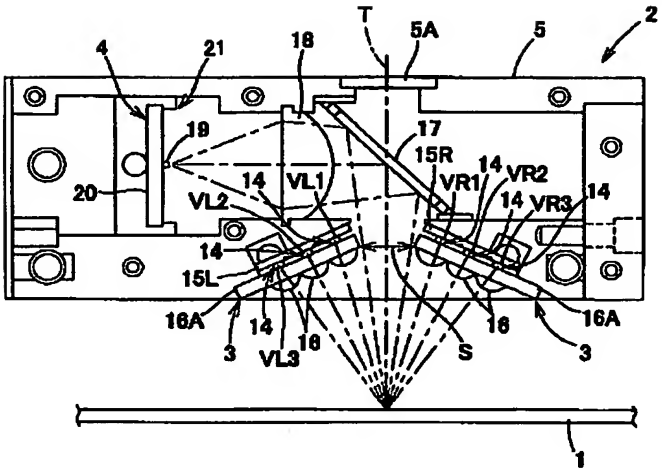
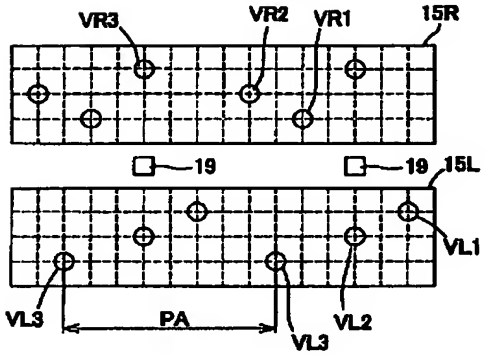
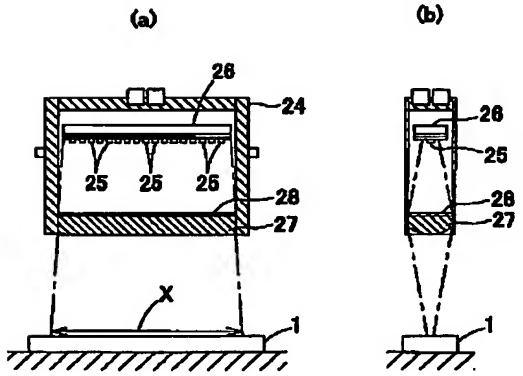


【図１２】



【図１４】



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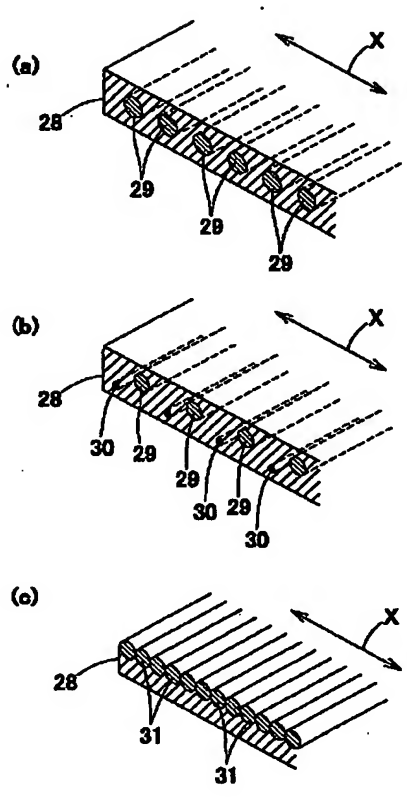
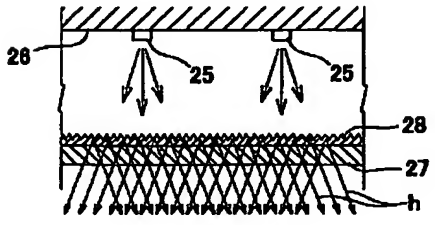
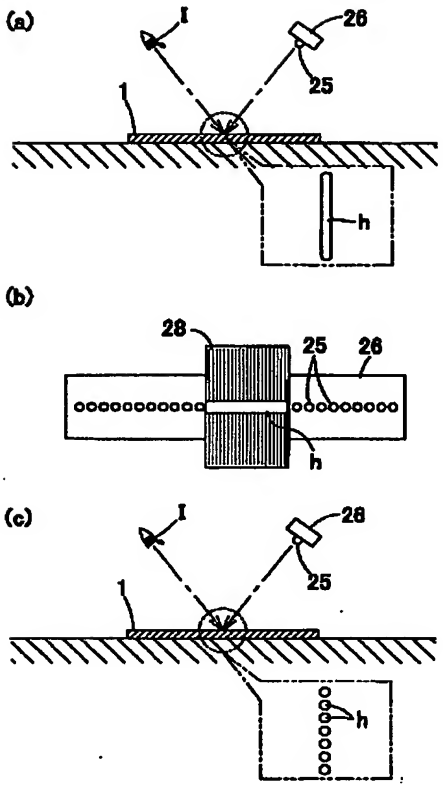


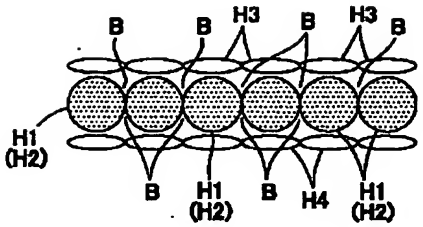
【図１９】



【図２０】



【図２１】



フロントページの続き

(72)発明者　杉田　隆
京都市上京区烏丸通下立売上ル桜鶴円町
374番地　シーシーエス株式会社内

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